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POWER

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May, 1935

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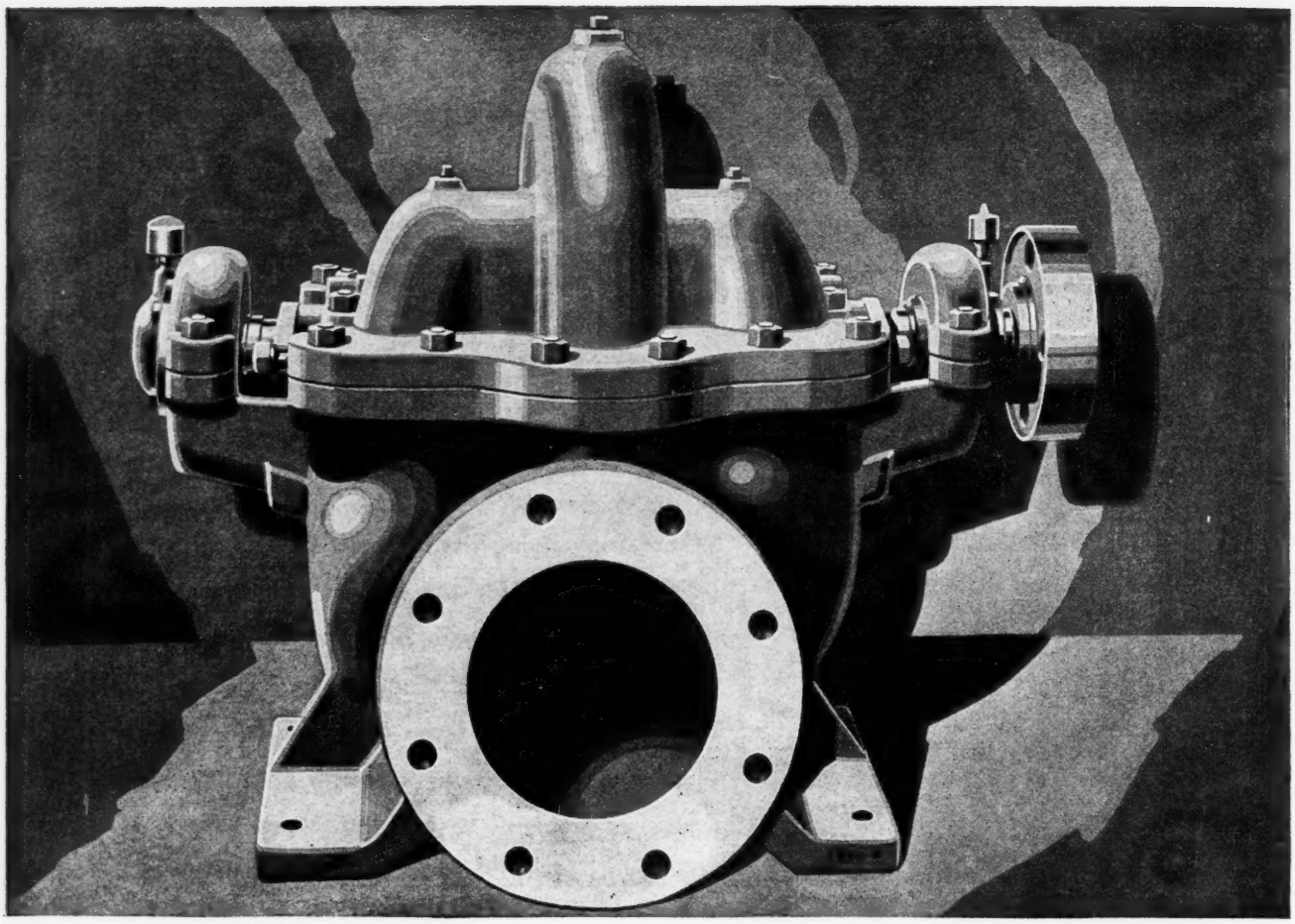

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POWER

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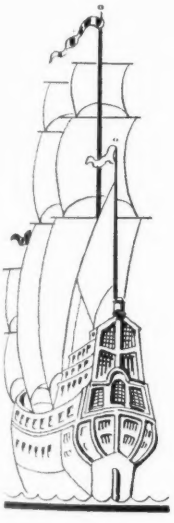
PHILIP W. SWAIN, *Editor*

SEA ROOM

THE MARINER feels safer when he is far from land. "Sea room" means freedom of action—particularly freedom to "heave to" in storms without fear of rocks or shoals. With sea room, and a master who knows his job, the sound ship can take it.

Because the winds of business, like those of the sea, can never be predicted far in advance, every individual business needs its own sea room. And so does every power plant and every power engineer. This is always true, in good times and bad.

Today there is no universal agreement as to the course of the nation's business. And it is perhaps just as well, because in times past, when all men have agreed, they have sometimes all been wrong.



Read your newspapers and magazines. Talk to business men and industrialists. Take a trip to some far-away section. Read the reports from Washington—from "inside" sources. Talk with the big shots, the men who know. Follow the business indexes. Read the great economists.

When you finish you will probably say, with Omar Khayyam, "Myself . . . did eagerly frequent doctor and saint, and had great argument, and ever more came out through that same door wherein I went."

These thoughts crowd on me because I am writing this in a hotel room in Atlanta, after driving through hundreds of miles of the old and new South. I have talked with managers and engineers in dozens of cotton mills and have studied their plants.

We don't talk depression. Mostly we talk machines and processes and seem to assume that life goes on about as usual. In the city hotels—Charlotte, Greenville, Atlanta—plenty of well-dressed folks tackle their fried chicken, candied yams and hot biscuit to the tune of good music in sparkling dining rooms. Thousands of new cars elbow the Model T's on the streets. John and Mary Citizen line up around the block for a show.

This, I guess, is depression. But I rarely hear the word down here.

In the vast expanses of this country you can find any views your heart may desire. My own personal hunch is that things are getting better, that work and profits are gradually coming to those who go after them, that it's wise for every business man and every engineer to concentrate on sailing his own cargo to a definite port, merely allowing himself plenty of sea room, so that he may "heave to" if need arise.

The mistake some make, I feel, is that they heave to when they might be hauling cargoes with reasonable safety. Such are those who refuse to modernize power plants even for a yearly return of 30 or 40 per cent. Takes money? Sure! But isn't the difference between 30 per cent on an investment in your plant and 4 per cent at the bank too high an insurance premium on today's risk of doing business?

For the life of me I cannot rate the present hazard so highly. We all need sea room, but not a thousand miles of it.

Philip Swain

Editor

PUMPING PATRIARCHS

FORCE and speed are the ingredients of power, but force, far more than speed, determines the size and cost of machines. That is why David has routed Goliath in the field of pumping.

Wonderful patriarchs, those old triple-expansion waterworks pumps, many still running sweetly after thirty years of operation! But, burdened with enormous size, weight and cost, these lumbering giants haven't a chance, on a new installation, against centrifugal units of one-tenth the weight and present cost. Those already in must hold their own, if at all, on performance alone. But even here they are losing first place because of steadily increasing efficiency of turbines and centrifugal pumps and the falling cost of energy for motor drives. To cinch the victory, the turbines are now taking advantage of the higher steam temperatures and pressures that cannot be used in existing engines.

SUMMER SENSE

IT IS A strange perversity of nature that the engineer has to think of heating in the summer and cooling in the winter. He has to, that is, if he expects to manufacture low-cost comfort in the season ahead, for it takes time to plan and install new systems, or even to put the old in tip-top shape.

Yet summer has its place as a time to plan air conditioning as well as next winter's heating. In many American cities, it's a sort of torture machine, designed to insure a ready "yes" to any sane proposal to end summer suffering.

In plain English, now is a good time to develop complete air-conditioning plans ready to submit on some July day when the mercury hits the roof.

HERE'S ANOTHER

IN HIS "Power Fallacies" page in January, the editor invited argument. He got his wish; discussions were published in March and April.

Now comes another, this time "debating the undebatable." A professor on the Pacific Coast challenges the statement "The new equipment," replacing existing equipment, "is a good investment if the saving in operating cost will yield an adequate return on the new investment." The professor insists that the investment must yield a satisfactory return on the combined old and new investments. Neither of us can understand the other's viewpoint. Practically, it makes a whale of a difference which view is correct.

Readers with definite views are invited to jump into the argument—but please keep within 200 words to leave room for all.

RED TAPE

AS SMALL organizations get larger, they grow more efficient in some respects. In others they go backward—so far sometimes that the small company nets a bigger percentage on its investment than the large.

Those who criticise bureaucracy in government should first inspect their own backyards. Take the matter of exchanging engineering information, for example. The small plant approaches the job without red tape. The chief engineer has the authority to use his own recognized good sense to decide what he can or cannot give out. Usually he finds little to conceal.

But take the big companies—at least *some* big companies. Official *A* thinks its O.K., but has to play safe by asking *B*, who in turn can't act until he checks with *C*. This old Army buck-passing game wastes time and energy, stalls progress.

DIESELS COME NEXT

ANOTHER special section is on the slate for June *Power*. Diesels this time—a table listing typical installations since Jan. 1, 1934. Also a directory of diesel makers and other unusual diesel data.

This is *Power's* third condensed handbook this year: First, Piping in February, then Maintenance in April. Three more of exceptional interest are scheduled for the second half of the year.

Please note that these special sections are not "digests" of material previously published in textbooks, handbooks, or technical magazines, but facts and ideas freshly gathered from the field, condensed and brought together in one place for quick reading and ready reference.

Their only purpose is practical helpfulness in meeting today's plant problems. Any suggestions?

POWER STANDS FOR

1. Making power when it should be made
2. Buying power when it should be bought
3. Cheaper power through modern equipment
4. Easier financing of equipment purchases
5. Better use of by-product heat and power
6. Operating methods that save money
7. Less waste in transmission and application
8. Prevention of smoke, within reason

MAINTENANCE BY ARC

By C. M. Taylor
Vice-President,
The Lincoln Electric Co.

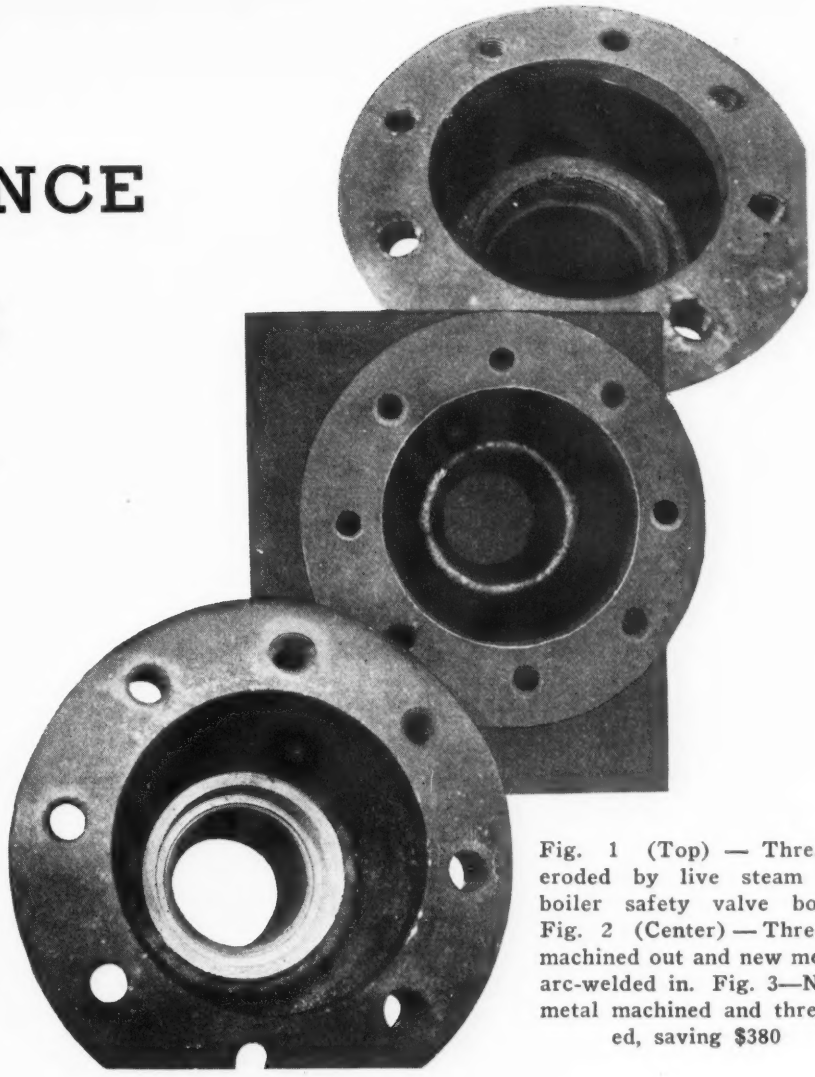


Fig. 1 (Top) — Threads eroded by live steam on boiler safety valve body. Fig. 2 (Center) — Threads machined out and new metal arc-welded in. Fig. 3—New metal machined and threaded, saving $380

VERSATILE and convenient, arc welding has reduced power-plant maintenance costs thousands of dollars annually. Immediate repairs can be made on broken or worn parts at a fraction of the cost of replacement, and without dismantling the machine. From mending a broken drive shaft, welding turns readily to applying a new hard-wearing surface on worn parts. It is simple; it is fast.

Steady improvement in arc-welding machines has given increased capacity, providing current and voltage of proper characteristics for best welding, and for faster work with larger sized electrodes (due to more uniform current which permits higher average current with less splatter and waste of molten electrode metal). Electrodes are now available for welding practically all industrial metals, including high-tensile steels, manganese steel, stainless steel, light-gage steel, cast iron and aluminum.

A large Midwest power plant reports savings of $3,000 in one year in rehabilitating shafts of roll-type pulverizing mills. Coal dust in the shaft bearings had worn them so that they required replacement. Journals were resurfaced with the arc, machined to proper size, and put back in service for less than $20 apiece, as compared with $60 apiece for new shafts, a clear saving of $40 each.

Valve Repairs

This same plant, which uses arc welding almost exclusively for maintenance, reports similar savings in repairing leaks between bodies and seats of valves in high-pressure steam and hot water service. Steam eating away the threads into which the seat is screwed, soon impairs valve efficiency, Fig. 1. To replace one valve costs approximately $400. Instead, the old threads are machined out and new surface built up by arc welding, Fig. 2, new threads cut and the valve put back in service for a total cost of $20. Fig. 3 shows the valve rethreaded.

Repair for 10%

Several 6-in. throttle closing valves in this plant had been repaired without success. Trouble was finally eliminated by making the seats of forged stainless steel and welding them into the body with a special electrode. The repair cost $60, instead of $750 to $1,000 for a new valve.

Cast-steel valves, the total replacement value of which in one plant is $3,700, have been reconditioned by welding for $500. Large high-pressure steam valves, costing about $1,500 each, are regularly repaired by arc welding for only $20 to $30 apiece.

One power plant reports $1,000 impellers on water-runners for high-pressure seals of large turbines rehabilitated for $15 to $20. The arc is also used in maintaining piping and installing supplementary

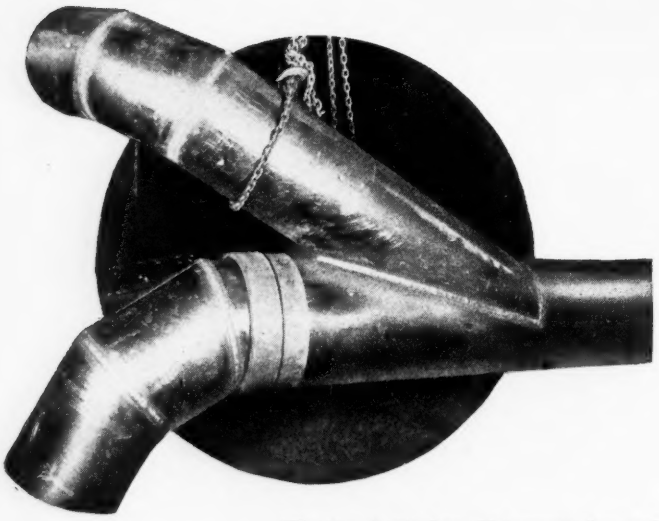


Fig. 4—A 30-deg. Y branch for valve and exhaust vents in a steam line

piping. One plant made oil lines from discarded pipe and boiler tubes. Several power plants have welded their own new piping, Fig. 4. For example, a large power plant in the South installed a 930-ft. line to handle steam at 600-lb. pressure and 720 deg. F. from boiler to turbine. Erected as a "spare-time" job by power-plant workmen, this line was built of 14-in. outside diameter seamless hot-drawn tubing 2$\frac{3}{32}$ in. thick. Tested at 1,500 lb. per sq.in. hydrostatic, no leaks were found.

Some Other Jobs

Other maintenance jobs handled with the arc include: Repairing cracked expansion joints, fabricating boiler ash-dump pans (which can be done for two-thirds the cost of the cast-iron type), maintaining soot ejectors, building and repairing pumps, building new chutes, racks, benches, structural work, brackets, bins, switch cells. All types of usable equipment can be made from scrap material.

DO'S and DON'TS for the SPRAYER OF METALS

By James W. Gibbons

Ass't Plant Engr., Brooklyn Refinery
American Sugar Refining Co.

SPRAYED molten metal coatings have failed in a number of applications and will probably fail in others for some time to come, not through faults in gun operation, but through lack of metallurgical knowledge. The most common error is to apply dissimilar metals, or metals of different potentials. Such difficulties can be avoided by careful selection and consultation with the gun manufacturer.

Avoid Burning

Many mechanical failures are caused by burning the metal while spraying an almost finished job. Bronzes and brasses are among the worst offenders, if overheated. Steel will burn but not peel off, but a bronze will change color and crack open like a crust of parched earth. This is usually caused by holding the gun flame too close to the metal and occurs when the operator is in cramped quarters or is over-anxious to finish a job. Of course, if the gun is held too far away, the opposite thing happens—the sprayed metal is cold when it strikes the surface and will not adhere properly, if at all.

Another fatal error is to try to spray the metal onto a surface not throughly cleaned and roughened with either sand or steel grit. Opinion is divided on whether sand or grit is better. We have found sand best suited to our purposes because it gives a cleaner, smoother job. Impingement of the particles is closer together than with steel shot. Sand-blasted steel surfaces under the microscope appear as if they were covered with millions of fine hairs or tentacles. These hold the sprayed metal from pulling away. Steel shot has a deeper impingement, but creates millions of small holes which do not seem to give the sprayed metal as good a hold on the base.

A clean, smooth surface is most important in application of a uniform coating. Even a skilled operator will allow thickness to vary, and it is almost impossible to tell exactly how heavy a coat has been applied unless it can be peeled off and measured. Instruction books and formulas point out that so much metal will cover so much surface at a given thickness, but try and do it. Just for experiment, take a piece of heavy polished plate glass which will not crack under heat, spray this with one coat, peel the coating off and measure it. Then spray on two coats, and measure thickness for comparison. The result will surprise you.

Bridging Over

Another difficulty, which occurs in filling pitted surfaces, is bridging of holes, which simply means spraying across a hole and leaving a gap under the metal which, if subjected to wear, soon breaks through. The best way to fill a hole from the bottom is to use a

low-melting point wire such as zinc, tin or lead. When the first flash coat has been applied all over the surface of the hole, hold the nozzle of the gun about an inch from the bottom of the hole. This will produce molten metal which will fuse and fill the hole rapidly, creating a solid mass of metal melted firmly onto the flash coat.

Fill all holes before spraying the surface. Whether spraying surfaces or pits, keep up constant air pressure on the gun, particularly when spraying metals of high melting point. Feeding of metal by the air turbine depends on air pressure, so if air pressure fails and the metal stops feeding for an instant, a plugged nozzle and tip will result. If the wire is high-carbon steel, the entire nozzle is plugged, bent, or otherwise destroyed. If it happens, it costs a hundred dollars for replacements, to say nothing of delay on the job. However, this has happened to us only once in a period of two years of almost constant use.

Successful Jobs

Here are several examples of jobs we have sprayed successfully. Two large cast-iron centrifugal pumps used for pumping river water to surface condensers were about to be scrapped, due to corrosion and erosion. We had tried all kinds of ways to save them—welding, plastic compounds of various kinds, even cement—but all failed, and the pumps were gradually getting worse. We finally decided to spray the surface. We built it up to original dimensions, but there were some very large holes in the casting which took a great deal of metal. Holes in housings (or casings) were filled with zinc over cadmium. When the surface was sprayed, the job seemed entirely satisfactory, and pump capacity was increased between 500 and 700 g.p.m.

After six months of use, the pumps were opened for examination. The zinc and cadmium were almost gone. Sprayed metal remaining was honeycombed and loose, apparently because we had bridged some of the deeper holes.

When we next sprayed this pump we tried to apply stainless steel to protect the zinc. A flash coat seemed to stick, but as soon as we tried to build the stainless steel to size, it curled up and broke away (of course, we were trying to put on sprayed metal as much as $\frac{3}{4}$ in. thick). We finally gave up the steel and applied zinc until all holes were filled and the surface smoothed up, then covered with almost a half-inch of phosphor bronze. We have not inspected this pump since, so do not know how this is working out.

East River Water

While the uninformed call East River water salt, it is more acid than anything else, and the foreign elements which compose it are highly injurious to metals, particularly cast iron. Though the river empties into New York Bay in one direction and into Long Island Sound in the other, no matter which way the tide is running, city sewage and factory and plant waste is emptied into the water. Pump screens will keep out debris, but not harmful liquids or material which attack cast iron. In pure sea-water, zinc is the finest protective coating.

An impeller shaft for one of our largest pumps could not be kept tight at the stuffing boxes, therefore we lost vacuum through the suction and could not pump water. We found the shaft was badly worn under the packing. This shaft was expensive, because it was Crucible stainless steel F-12, heat-treated and hardened, worth about $90 in the rough, and finished with a marine thrust bearing on one end, machined on the other to fit a special coupling and threaded at each side of the center for nuts to hold the impeller in place. The shaft was taken out, undercut where the packing had worn out, sprayed with high-carbon steel and ground to size. This repair has been entirely satisfactory.

Another shaft was worn flat on two sides for about $1\frac{1}{2}$ in. It carried four gears, a bevel gear, a sprocket and a clutch. To attempt renewal would have cost quite a bit, to say nothing of loss of production. We, however, took it out with all mechanism on it, built it up, machined it and put it back into service in about $1\frac{1}{2}$ hr.

When we spray sheet-metal tanks, etc., we are very careful to clean the metal properly. In tanks supported inside with braces, we weld up joints of tie or angle iron to the braces to avoid the material in process from getting behind the tee or angle irons and forcing its way under the sprayed coating.

Watch Wire Size

We have found it best not to follow rules and sizes too closely in selecting wire for spraying. For example, with aluminum wire the size recommended is No. 19, but this is too small and curls up in the gun chamber and jams the gears. I have found that other users have had this same trouble. We use No. 13-15 wire with good results.

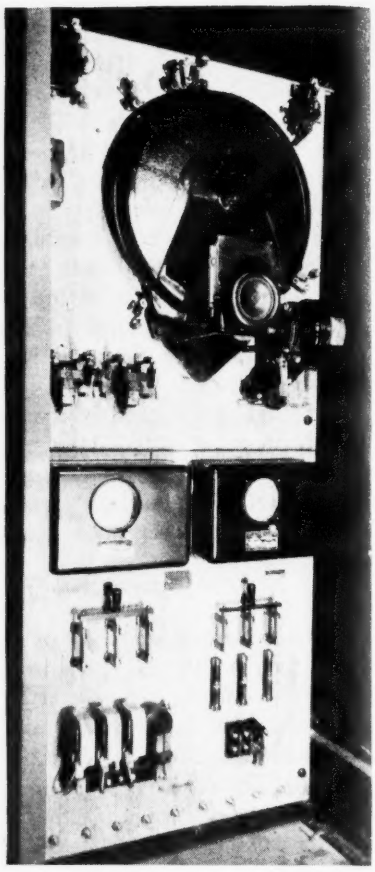
There are many other things which could be written on this subject and many which as yet are unknown. The only possible way in which to gain the maximum benefit from the process is to use sound judgment and to experiment continually, then to share the results of the experiments with other users of the process.

Chipping out surplus sprayed molten metal filling a defect in a steam-turbine diaphragm. Photo, courtesy Metals Coating Co. of America

CONSTANT PRESSURE *by* Variable-Speed Pumps

By I. L. Boyum

Engineering Department,
Westinghouse Electric & Mfg. Co.



Complete automatic water-pressure regulating panel

EVERY water supply system, be it municipal, industrial or residential, presents a problem in maintaining constant delivered-water pressure. Too low a pressure may cause failure of water in parts of the system; too high a pressure increases pumping and maintenance costs. Three systems are in general use to maintain approximately constant pressures: the pneumatic or sealed reservoir, elevated-tank, and continuous running centrifugal pumps discharging directly into mains and equipped with some means to govern discharge pressure according to demand.

For the latter type of installation, an entirely electrical pressure regulation system is available. The system includes a variable-speed motor on the pump, a pilot-motor operated rheostat in the motor secondary circuit, a set of pilot-motor control contactors and pressure regulators to position contactors. This control uses two separate pressure regulators, one for low pressure and one for high pressure.

Assume that pressure required on the system is 70 lb. per sq.in., the low-pressure regulator is set for 67 to 70 lb., the high-pressure for 70 to 73 lb. If system pressure falls below the required value, the low-pressure regulator would close at 67 lb. This would increase the speed of the motor until a pressure of 70 lb. was obtained. Since a change of 3 lb. either way is required to close a contact to change the speed, there is a total range of 6 lb. over which pressure can vary without operating the speed-changing device. By this arrangement, frequency of control operation has been decreased and "hunting" eliminated.

Any one of several speed-changing devices may be used, preferably motor-operated types. On motors up to approximately 50 hp. a motor-operated face-plate type is most satisfactory. With this type, resistance is varied directly from the face plate, which is simple and has a fairly large number of steps for close regulation. For motors up to and including 100 hp. and on smaller motors where a limited number of steps will provide satisfactory operation, a motor-operated drum controller is used. For large motors and on smaller motors where conditions require it, a drum-type master switch with motor operating head is selected. This master drum controls contactors and adjusts the resistance in the secondary of the motor.

In all these controls the drum is not driven at a uniform speed but moves rapidly from one position to the next, then hesitates on each operation position. This eliminates burning of contacts and insures completion of each individual step. A complete control also includes a primary contactor interlocked so that if it opens, the drum control returns automatically to full-resistance position. The control also is so arranged that the primary contactor cannot close until the drum control returns to full-resistance position.

The usual arrangement of this system is semi-automatic, in which the operator pushes a start button to close the primary contactor, after which pressure is regulated automatically. A full-automatic system can be used, where an operator starts the first pump, after which additional pumps are connected as increase in load warrants. Shutting down can be either manual or automatic with either the manual or automatic start. For industrial systems, where the demand over a 24-hr. period follows a rather definite cycle, units can be started and stopped by a time clock and have the pressure controlled automatically.

Pressure Control of Speed

The two devices with gages in the center of the control panel illustrated are the pressure regulators, one for low pressure and one for high pressure. Contacts of these pressure regulators operate the two small contactors immediately above the left-hand pressure regulator. These contactors operate the pilot motor immediately above the right-hand pressure regulator. At the top of the panel the large device is a 3-phase faceplate for controlling the secondary of a slip-ring motor. The knife switch and contactor on the lower left-hand side are for the primary of the motor, the knife switch and fuses on the right-hand side for the control circuit.

BUYS POWER *to* SAVE 26%

By F. W. Bailey

Union Gas & Electric Co.

COST of power services to the 15-story Cincinnati Traction Building, designed for future addition of three stories, was reduced $6,434 a year by changing from generated to purchased power and by changes in elevator equipment and operating methods.

The original plant contained three 75-kw., 125-volt d.c. generators driven by vertical cross-compound steam engines, supplied with 160-lb. steam from two 3,000-sq.ft. Babcock & Wilcox boilers fired by Roney stokers. Five hydraulic elevators, four passenger and one freight, are served by a 3-cyl. cross-compound corliss valve heavy-duty pumping engine supplemented by two simplex tandem-compound pumps and one duplex pump used after midnight. Auxiliary steam-driven equipment consisted of five small vertical locomotive-type air compressors, a small duplex ice-water circulating pump, and two simplex boiler feeders.

About 3,000 kw.-hr. of central station power were used per month for Sunday and late-night operation, the output of the generating plant being about 268,000 kw.-hr. a year. Exhaust steam was used as completely as possible for building, space heating and hot-water supply.

Flowmeters, condensate meters and graphic electric meters were installed in 1932, and a study made of steam and electric requirements and cost, together with heat balance, load curves and cost estimates for various operating methods. During the 12-month period, 24,677,000 lb. of steam were generated by 1,712 tons of coal, an average evaporation (including all standby losses) of 7.2 lb. per pound of coal as fired. About 53% of the high-pressure steam was used in the engine-generator set, 31% was used by elevator pumps, 8% in steam-driven auxiliaries, and about 8% was makeup and unaccounted for. About 21,293,000 lb. of steam (86% of all high-pressure steam) was available as low-pressure exhaust, of which about 10% was utilized in heating boiler feedwater, 2.5% in hot-water supply, and 30.5% for building space heating. The remaining 57%, or 12,109,000 lb. of exhaust, was wasted to atmosphere.

Data from these tests and cost records showed that the lowest total cost would be obtained by purchasing all electric power, by using motor-driven pumps for elevator service in the non-heating season and by using the 3-cyl. corliss crank and flywheel pumping engine for elevator service during the major portion of the heating season, utilizing its exhaust for building space heating and reducing winter peak demands on purchased power service. All steam-driven auxiliary pumps (except boiler feed pumps) and compressors were to be superseded by motor-driven equipment.

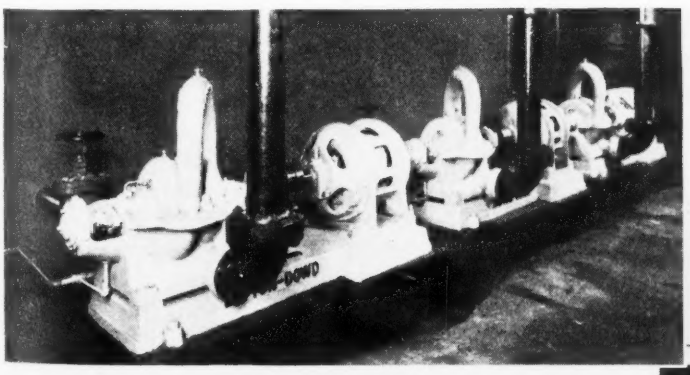
These changes, including piping and wiring connections, cost $5,600. To change from the hydraulic elevator to modern manual-control electric elevators would have cost about $110,000, and the resulting operating saving of $3,000 to $3,500 a year did not justify the investment at this time. When demands for office space indicate the addition of three more floors, installation of electric elevators will probably be undertaken.

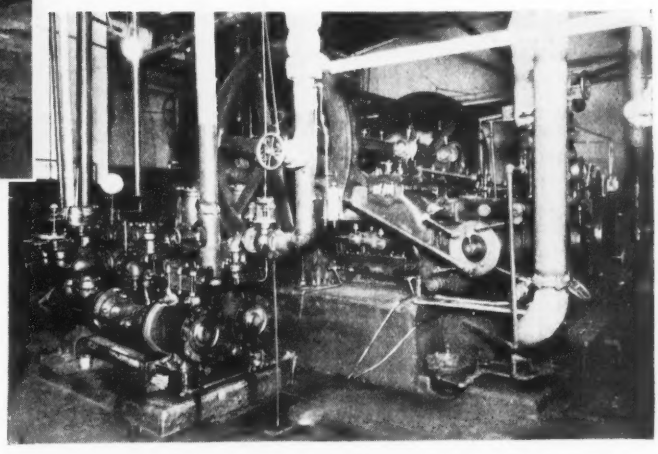
The new elevator pumps shown in Fig. 1 consist of three 2-stage, 300-g.p.m. centrifugal units driven by 30-hp. motors, and equipped with automatic pressure control arranged so that one pump runs almost continuously during 8 hr. of daytime operation; the second pump is started up if pressure drops 5 lb. and the third unit, a reserve, operates only if pressure drops 10 lb.

The 12-month period immediately following the change-over to purchased electric power, May 1, 1933, showed a net reduction in total operating expense of $6,434, from that of the period immediately preceding, which was $24,850, for practically identical service.

Last November the old stokers were superseded by modern underfeed side-dump stokers, which it is estimated will effect further reduction in total cost.

J. H. Bohman, chief engineer, designed the installation and placed the new equipment wiring and piping.





During the summer the three 300-g.p.m. electric pumps above replace the 3-cylinder 14½ x 18 and 18x7½x24-in. compound crank and flywheel elevator pumps at right.

ABOVE 250 LB. FAVORED FOR

By L. E. Newman
Turbine Department,
General Electric Company

POWER plants are emerging from depression with almost unlimited possibilities for large gains in economy of operation. During the past four years, modernization has received a serious setback. "Drying up" of buying power has been most keenly felt in sales of new equipment, but also to some extent in sales of supplies for existing sets. Latent buying power has been stored, advances in the art have been made.

We have studied the effect of the depression on purchases of new turbine-generator sets, purchases of supply parts for existing turbine-generator sets, and the various ways in which industries have achieved modernization in their turbines and generators. (This particular study covered the classification of ratings of 500 to 7500 kw). Modernization receded during the first three years of depression, and not until the fourth year was there an appreciable upturn. This recession included purchases of new equipment, replacement of worn parts, and rebuilding for more favorable steam cycles.

Modernization of turbine-generating equipment usually takes one, or more, of the following forms:

I INCREASING INITIAL PRESSURE AND TEMPERATURE
  a. Replacing existing turbine-generator by more efficient one of same or greater capacity.
  b. Replacing the turbine and using the old generator.
  c. Rebuilding turbine.
  d. New high back-pressure turbine to exhaust to existing station pressure.

II. RECOVERY OF WASTE HEAT
  a. Installation of mixed-pressure turbine.
  b. Installation of waste-heat-governed low-pressure condensing turbine.

III. REPAIRS TO EXISTING UNITS
  a. Increase in efficiency, or decrease in maintenance by replacing worn parts.

IV. INCREASING EFFICIENCY OF HEAT CYCLE
  a. Installation of non-condensing turbines.
  b. Installation of extraction turbines.

V. MODIFICATION OF GENERATORS
  a. Rewinding for higher voltage.
  b. Installation of generator surface air coolers on existing machines.

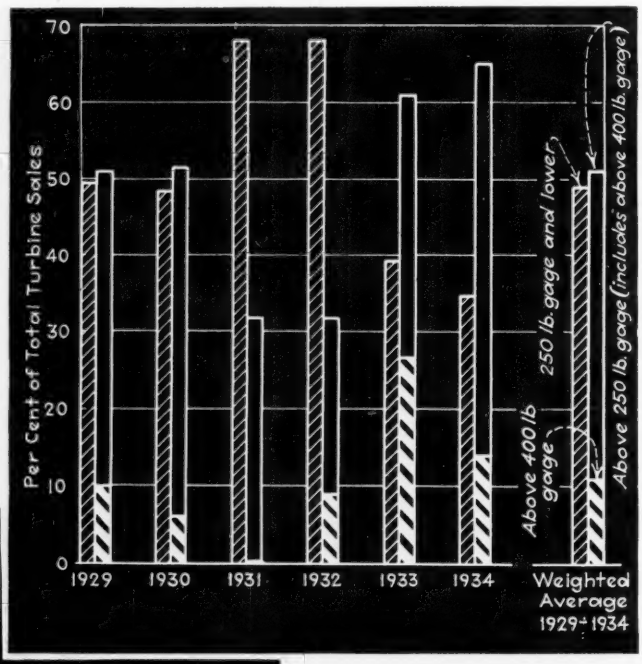
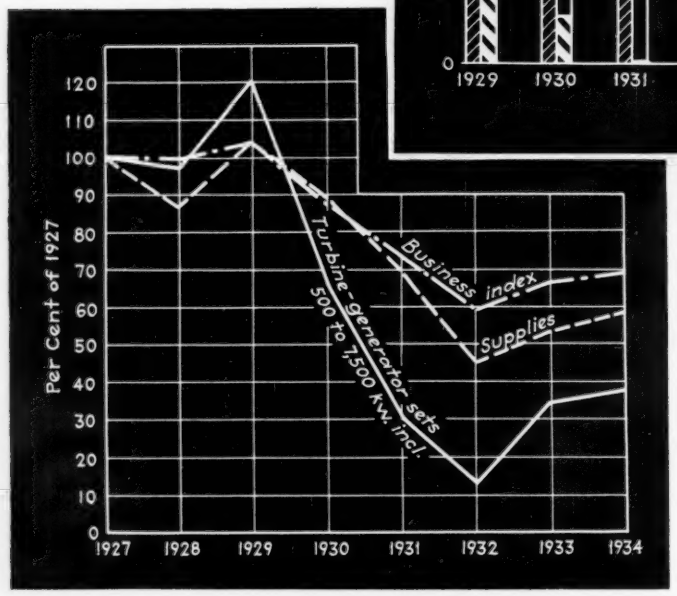


Fig. 1 — Classification of 500- to 7,500-kw. turbine sales according to pressure

Fig. 2 — Comparison of turbine and turbine supply sales with business index



A measure of advances made in improved heat cycles has been the sales of turbines for high pressures and temperatures. Over a period of years average throttle pressure of turbines sold each year has constantly risen from an original pressure below 150 lb. gage to an average pressure probably double that today. Up to 1929, each year showed a reduction in sales of turbines for pressures below 250 lb., and a growing demand for turbines designed for initial pressures above 250 lb. By 1929 the higher-pressure bracket had passed the lower-pressure bracket, and pressures above 400 lb. were becoming common. Fig. 1 shows a segregation of these sales by initial pressure, and it is interesting to note that the upward trend in pressures stopped in 1930, receded in 1931 and 1932, and resumed its upward trend in 1933. We believe that this trend will continue upward.

Analysis of individual cases to determine reasons for this recession in sales of turbines for higher pressures

NEW STEAM TURBINES

For three years of depression, modernization dropped off. Now it's coming back. Here are listed steam turbine types that are leading the upturn

indicated an unwillingness of purchasers of new equipment to increase their capital expenditures more than the minimum required to keep their plants in operation, regardless of possible savings resulting from increased expenditures. Units were, therefore, purchased for operation with old boilers at existing pressures and temperatures. Some of these turbines were bought on the basis of being designed for future higher pressures and temperatures, but suitable for present operation with existing boilers.

Large returns on investments made in apparatus to recover waste heat have been made by some industrials able to install low-pressure condensing and mixed-pressure condensing turbines. These machines were called "depression turbines" because they made possible an increase in generating capacity and improvement in heat balance without increasing boiler capacity.

It was pointed out earlier that capital expenditures were greatly curtailed during the depression; expenditures for rebuilding and repairing existing units were curtailed much less. Fig. 2 compares the sales of new units, and supplies for existing units, with the general business index. Sales of capital equipment appear as an exaggerated business cycle, whereas sales of supplies follow the same general curve, but are less depressed by poor business conditions and less improved by good business conditions.

From the standpoint of maintenance, as would be expected, machines were allowed to operate with badly worn parts. Where the power plant had several machines installed but only required one or two of them to carry the load, the others were robbed of parts for machines in operation. As a result, when business again began to show life, and loads increased, operators found many machines in need of repairs. Each wave of business activity carried with it large increases in supply orders. Indications for 1935 are a continuation.

As business continues to improve and power plants seek additional generating equipment, it may be expected that the bulk of new machines will be of extraction and non-condensing types, designed in most cases for operation with high pressures and temperatures. Capital expenditures will be made at first only on equipment which will yield a high return, and turbines exhausting or extracting to process will give this high yield.

Three Bad Penstock Accidents in 1934

1934 was unusual in the annals of water-power history in that it recorded at least three serious penstock failures. Two of these were in Europe and one in the United States. The first one occurred on Jan. 4 when the main pipeline to the Lac Noir pumped-storage hydro-electric plant, France, ruptured near the plant and caused serious damage to plant and equipment. (This plant when completed will have four 40,000-hp. vertical-shaft units.)

A single tunnel and penstock about 0.5 mi. long and 18 to 15 ft. in diameter connects Lac Blanc with the plant on Lac Noir, giving a maximum head of about 400 ft. Two units had been in operation about two months when a manhole connection failed and caused a rupture about 25 ft. long by 8 ft. wide in the main penstock. The fracture was in sound metal outside of all welds. This pipeline had been tested after erection to twice maximum static pressure for 3 hr. and the welds subjected to a hammer test. Rupture is attributed to a chain of unfortunate circumstances.

The second accident was in Spain at the Esla River project of the Saltos del Duero Co. The power house is at the foot of the dam and is designed for four 37,000-kva.. units, two of which have been installed. A penstock 11.5 ft. diameter extends through the dam, which is 328 ft. high, to each unit. When the accident occurred, two units were installed. The other two penstocks had their upper ends closed with stoplogs. June 8 the stoplogs failed. Although the plant was not seriously damaged, it was necessary to drain 35 billion cubic feet of water to replace the stoplogs.

The third penstock failure was at Hawks Nest plant on the New River, W. Va. and occurred in a manifold branch leading to one of the five 14-ft. penstocks. This plant has four 35,000-hp. units installed to operate under a 157-ft. head. The main penstock and manifold is about 320 ft. long and varies in diameter from 30 to 14 ft. The manifold and penstocks are all electrically welded. All the welds were stress-relieved and were X-rayed where possible. Without warning, while a hammer test was being applied to one of the manifold branches leading to No. 3 penstock, under hydrostatic pressure, a break occurred.

These failures resulted in the loss of 23 lives and large property damage, which emphasizes the seriousness of such accidents. Whatever the causes, they stress the need for extreme care in design, construction, testing and putting into operation of large hydro units.

SERVICE AS USUAL

A new plant has been built over the old generating plant in foreground

By A. C. Kirkwood

Burns & McDonnell Engrg. Co., Kansas City, Mo.

MC PHERSON, Kansas, a city of some 7,500 people, lies near the center of the state and is the agricultural and industrial center of a considerable territory. The city entered the electric utility business in January, 1909. Since that time its business has constantly expanded, until it now serves its own needs and the greater part of the adjacent oil fields and agricultural area. The original power plant used reciprocating engines, but as load increased these were gradually replaced by higher-pressure and more economical turbogenerators. Present generating equipment comprises three turbine units, rated 500, 750 and 2,000 kw., operating on steam from two gas-fired boilers.

Late in 1933 consulting engineers were retained to study the plant and operating conditions with the object of increasing plant capacity and improving economy. The engineering report was rendered in November, 1933, and the City Commission decided to adopt the suggested improvement program.

Application was made to the P.W.A. for a loan and grant to finance the cost of plant betterments, and after some delay an agreement was reached. Before conclusion of these negotiations, private financing agencies offered to accept the city's revenue bonds for that portion of cost not covered by the Federal grant. Their offer was so attractive that the City withdrew its application for a loan and accepted only the grant. First equipment contracts were placed in June, 1934, and the entire program will be completed by July, 1935.

Scope of Improvements

Features of the improvement include a 3,000-kw., 400-lb. condensing steam turbine arranged for extraction for feedwater heating, a surface condenser and auxiliaries, heat-balance equipment, a 5,000-g.p.m. forced-draft cooling tower, new boiler-feed pump, piping, wiring, switchboard improvements, and a new turbine room equipped with a 25-ton crane. It was unnecessary to increase boiler-plant equipment except to install an induced-draft fan on a bypass stack. The fan is used during high loads only when natural-draft capacity is exceeded.

The impulse turbine-generator with one 2-row velocity stage will be bled at the 4th, 8th and 10th stages for feedwater heating. High-pressure bled steam will be used at available pressures in the evaporators and drains to the deaerating feedwater heater and combines, with the evaporator vapors at 5 lb. gage. Steam from the 8th and 10th stages will be used alternately in the low-pressure closed extraction heater, 10th-stage steam being used as long as pressure remains above approximately 5 lb. abs. When pressure drops below 5 lb., a changeover to 8th-stage steam will be made automatically by a bleeder-stage selector valve. The 2,000-kw. unit has been rearranged so steam will be bled as it is from the 3,000-kw. machine except that it will have only one low-pressure extraction stage.

The 3,000-kw. generator has a direct-connected, totally enclosed exciter cooled by the generator air cooler. A filter in the discharge-air duct from the exciter will remove carbon dust from the exciter brushes.

A 5,000-sq.ft., divided-waterbox, two-pass condenser serves the turbine. Tubes, all to be removed from one end, are plain-ended and anchored at the inlet end by compression fittings, outlet ends being equipped with ferrules and packing rings. The condenser, at right angles to the turbine shaft, is rigidly supported on steel beams between the concrete turbine columns. The unit is close to the building wall, and a short tunnel is provided outside the basement.

Two 75-g.p.m., motor-driven pumps will remove condensate, passing it through the after-condenser, low-pressure extraction heater, and to either the deaerator or elevated surge tank. One pump is sufficient for full turbine and condenser capacity, the second pump being a standby. An additional 65-g.p.m. condensate pump on the 2,000-kw. unit insures uninterrupted service.

Two 2,300-g.p.m. circulating-water pumps serve the 3,000-kw. unit. They are connected so that either pump can be used with either half of the condenser. A triple, 2-stage, air ejector removes air from either or both condenser air-cooling zones. The inter-condenser drain

DURING ALTERATIONS

To McPherson, Kan., municipal steam plant. A new power house was built around the old one and a 3,000-kw., 400-lb. turbine and forced-draft cooling tower added

connects to the condensate-pump suction header through a small flash tank. Flash steam is vented to the main condenser shell about midway between the top and bottom tube banks. Condenser shell is welded steel; water boxes cast iron; and the flexible expansion joint copper.

A natural-draft cooling tower supplied circulating water to the old plant. Space limitations prevented satisfactory extension of this tower or installation of another unit in an adjacent windswept area. Therefore, the existing natural-draft tower was replaced by a forced-draft type, put into operation during the 1934 heat wave. This tower is rated 5,000 g.p.m. with a 15-deg. cooling range and 10-deg. approach to a 70-deg. wet bulb. Six multi-bladed fans are driven by seal-clad motors and multiple-V belts. Tower piping and basin are designed so that half the tower can be taken out of service without interrupting the other half. Each condenser has its own circulating pumps, and there are two sets of hot- and cold-water lines between plant and tower, these lines being connected to form a loop header.

The 3,000-kw. turbine is served by a 150-sq.ft. closed extraction heater connected through the automatic bleeder-stage selector valve. A closed heater (made from a converted high-heat-level condenser in the former heat-balance layout) serves the 2,000-kw. turbine. Heaters are in the boiler room and have sufficient static head to give free drainage of the condensers. The deaerating feedwater heater and the two evaporators are above the closed heaters at an elevation that insures ample static suction head on the boiler-feed pumps. An abandoned city-water standpipe about 130 ft. from the deaerator provides a combined surge and condensate-storage tank. The surge tank connection is just ahead of the deaerator admission valve. A cross connection between the deaerator inlet and outlet connections and a city-water connection to the boiler-feed-pump suction line provides for emergencies. All emergency valves are at floor level within easy reach of the boiler operator. Heat-balance equipment is grouped and will be under control of the boiler operator.

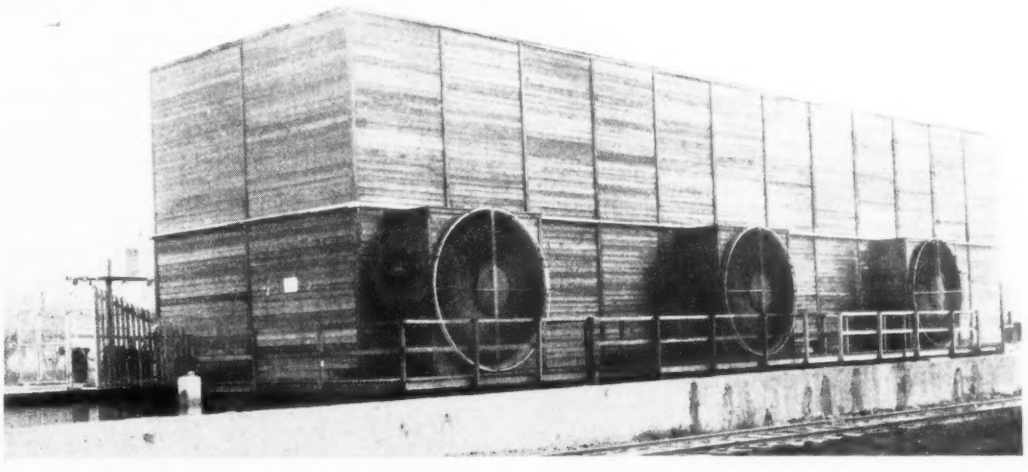
Evaporators

Evaporators are on a platform with the deaerator, at an elevation where coil drips will drain to the deaerator without pumping. They will be controlled manually and be operated at a rate to maintain satisfactory water level in the surge tank. They will generally be operated at high rates during high loads and shut off when the load is light. One new unit, rated 1,500 lb. per hr., was purchased, and an existing 700-lb.-per-hr. high-pressure unit is being re-installed.

After considerable investigation of pumps and drives it was decided to install a triplex boiler-feed pump driven by a 4-speed motor operating at 1,200, 900, 600 and 450 r.p.m. A pressure-relief governor in the discharge line bypasses excess water to the suction manifold, and spring-loaded relief valve gives additional protection to the pump, which is rated at 75 g.p.m. at 1,150-ft. pumping head. This unit and duplex steam-driven pump are in the turbine-room basement, because the boiler room has no basement, the gas-fired boilers being set above grade.

All piping now being installed is welded except for small low-pressure lines. Drip and drain lines subject to corrosion are made of wrought iron.

The turbine room formerly was a low, sloping-roof, brick building, adequate for the original steam engines



Forced-draft cooling tower for 3,000-kw. turbine-generator, is rated 5,000 g.p.m. with a 15-deg. cooling range and a 10-deg. approach to a 70-deg. F. wet bulb

PRINCIPAL ADDED POWER EQUIPMENT

City of McPherson, Kan.

Turbine-generator, 400-lb. steam, 3,000 kw., 0.8 p.f., 2,300 volts, 3,600 r.p.m. ..... Elliott Co.
Air and oil coolers ..... Griscom-Russell Co.
Condenser, 2-pass, divided waterbox, 5,000 sq.ft., 0.75-in. x 16-ft. tubes ..... Westinghouse Elec. & Mfg. Co.
Condensate pumps, two 75-g.p.m. (1-65 g.p.m. added to 2,000 kw. unit) motor driven, at 1,160 r.p.m. Westinghouse Elec. & Mfg. Co.
Circulating-water pumps, two 2,300-g.p.m. De Laval Steam Turbine Co.
Driven by Westinghouse 1,150-r.p.m. motors.
Air ejector ..... Westinghouse Elec. & Mfg. Co.
Forced-draft cooling tower, 5,000-g.p.m., 15-deg. F. range, 10-deg. F. approach, 70 deg. F. wet bulb. Marley Co.
Cooling-tower fans, six, 120-in. dia. ..... Marley Co.
Fan motors ..... Allis-Chalmers Mfg. Co.
Induced-draft fans, one 20,000-c.f.m., one 14,000-c.f.m. Buffalo Forge Co.
Driven by 2-speed Westinghouse motors.
Boiler-feed pump ..... Worthington Pump & Mach. Corp.
Fuel-oil pump ..... Worthington Pump & Mach. Corp.
Deaerator heater, 50,000 lb. per hr., 225 deg. F. outlet temp. ..... Elliott Co.
Closed heater, 150 sq.ft., 0.5-in. x 9 ft., 10-in. tubes Elliott Co.
Evaporator, 57 sq.ft., 1,500-lb. per hr. output Griscom-Russell Co.
Boiler-feed-pump relief regulator (Copes) Northern Equipment Co.
Desuperheater controller Consolidated Ashcroft Hancock Co.
Deaerator pressure regulator ..... Fisher Governor Co.
Liquid-level controllers ..... Fisher Governor Co.
Bleeder check and non-return valves Schutte & Koerting Co.
Safety valves ..... Consolidated Ashcroft Hancock Co.
Heater-overflow relief valves ..... Fisher Governor Co.
Cast-steel and iron valves ..... Chapman Valve Mfg. Co.
Forged-steel valves ..... Edwards Valve & Mfg. Co.
Tilting-disk check valves ..... Chapman Valve Mfg. Co.
Traps ..... Armstrong Machine Works
Evaporator-coil drainers ..... Cochrane Corp.
Heater drainers ..... Fisher Governor Co.
Separators ..... Elliott Co.
Expansion joints ..... Joseph Kopperman & Sons
Piping fabrication ..... Midwest Piping & Supply Co.
Piping contractor ..... Inter-State Heating & Plumbing Co.
Crane, 25-ton, single-motor ..Shaw Box-Crane & Hoist Co.
Unit heaters ..... Perfex Radiator Co.
Water meters ..... Neptune Meter Co.
Meters ..... Consolidated Ashcroft Hancock Co.
Air compressor ..... Ingersoll-Rand Co.
General building contractor ..... M. C. Foy & Son
Wiring contractor ..... Atkinson Armature Works

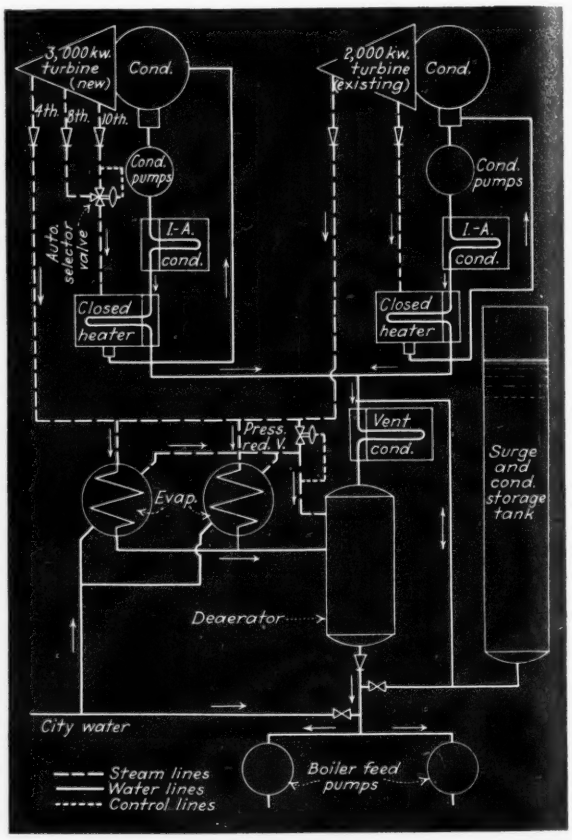
and smaller turbines. A considerable addition was needed for the new unit, therefore the City Commission decided to build a new turbine room around the old. The turbines were enclosed in a temporary wooden structure, the old building removed, and a new turbine room built around the old equipment. Service was maintained without interruption. A 25-ton single-motor traveling crane will serve all turbines and, through removable floor sections, all basement auxiliaries. All heating is done by unit heaters with extraction steam taken from the deaerator steam line.

Improvements now being made are predicated on a detailed study of existing operating records. In 1921, the first full year of operation, the plant generated 1,197,536 kw.-hr. Since then load has grown fairly steadily to 7,452,040 kw.-hr. in 1934. Particularly noteworthy are the figures for the last several years, growth having continued right through the depression. The peak in 1932 was approximately 1,100 kw.-hr., in 1933 it grew to about 1,400, and in 1934 it reached 1,750. In 1935 it will again increase materially due to addition of considerable whiteway lighting and expected increases in industrial-plant load.

Natural gas used under the boilers has a heat content slightly in excess of 1,000 B.t.u. per cu.ft. Daily records show an average consumption of as low as 21.1 cu.ft. per kw.-hr. generated. The average for 1934 was 24.8 cu.ft., or approximately 25,000 B.t.u. per kw.-hr. generated. Design data for the improved plant indicates a satisfactory improvement on this record.

The City Commission comprises E. C. Crary, mayor; W. R. Carlson, commissioner of streets and public utilities; and A. W. Bremyer, commissioner of finance and revenues. L. C. Angevine is superintendent of the Water and Electric Department. Burns & McDonnell Engineering Company, Kansas City, Mo., prepared the report and has charge of design of the improvements now being installed.

Simplified flow diagram of heat-balance equipment



Reserve Capacity

DOES HABIT or logic determine the amount of reserve capacity installed in new power plants? Reserve, of course, is insurance, but it costs a lot—often more than it's worth. Its value today is less than formerly because today's power equipment is more reliable.

The logic of these changed conditions already finds recognition here and there. Some engineers have even had the courage to put all eggs in one basket—build a plant with a single boiler and a single turbine.

More still insist, with reason perhaps, on some reserve, but why penalize power costs with standby units as efficient and costly as those harnessed for regular service? Some of the old units, left in, should do the trick. If these must be cleared out, for lack of space, there's still the possibility of gasoline engine sets or other low-cost reserve capacity.

OPERATING PROBLEMS AT LYNN

*By James A. Cook**

General Manager
Lynn Gas & Electric Co.

IN THE new section of Lynn Generating Station are two 400-lb., 700-deg. boilers which supply steam to a 20,000-kw., 13.8-kv. turbine-generator. Each boiler is capable of operating the turbine at an output of 15,000 kw. When the turbine is down for overhauling, 400-lb. steam is reduced to 200 lb. and used in the older 17,800-kw. part of the station.

With motors aggregating 1,269-hp., the coaling plant handles 100,000 tons of steam and gas coal a year. Vessels dock at the plant, and coal is discharged from them by two towers free to operate the length of the 650-ft. wharf. The towers discharge into storage piles and also reclaim coal from storage, crush it and deliver it to a traveling belt where it is automatically weighed and conveyed at 100 tons per hour to the hoppers of the boiler plant. Both towers working simultaneously can handle 400 tons an hour. During the duty cycle, which is about 27 sec., electrical peak demands frequently exceed 2,000 kva. Station load during coal hoisting varies from 5,000 to 20,000 kw., depending on the time of day. These conditions presented a problem in voltage dips on the 4.4-kv. main station buses. These dips were eliminated by constructing next to the coal wharf a stepdown substation supplied at 4.4-kv., from which energy is delivered to the towers at 575 volts over two parallel No. 0000 grooved trolley wires per phase. These wires are run the full length of the wharf and are tapped every 40 ft. from a 800,000 circular-mil parallel feeder cable.

Condenser Tube Difficulties

Placed in operation in 1929, the condenser on the 20,000 kw. turbine had to be retubed in 1930. In the past five years considerable progress has been made in reducing these condenser-tube troubles. Probably the chief factors in prolonging condenser-tube life have been scheduled annual cleaning of the circulating tunnel and semi-annual cleaning of the screen wells. A vent pipe placed over the intake well to release entrained air also had a beneficial effect.

Another step toward improving these conditions was to drill seven 1-in. holes in the crown of each half of the division plate above the inlet water boxes, allowing a small amount of water to bypass the condenser and flow directly into the outlet water box. This water carries with it a considerable portion of the entrained air bubbles. Air take-off pipes were installed in the top of each inlet water box and extended to the high vacuum point in the outlet water box. Dams installed in the condenser circulating water discharge piping keep the condenser full of water even with the circulating water pump out of service.

When the first pass was retubed, 30 Yorcalbro tubes were installed at the top of the section where they are exposed to severe corrosion. Since then three other kinds of tubes have been installed, as well as Admiralty tubes of another make in an effort to find a tube material better able to withstand local conditions.

Water boxes were painted carefully with two coats of Apexior paint after being well cleaned with wire brushes. Thus far, experiments with different materials indicate that the Yorcalbro tubes have shown least corrosion. Composition of other tubes being tested is:

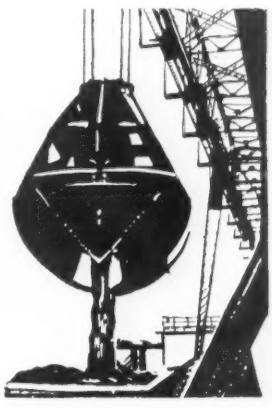
Ambrac "A" installed '32, 70% copper, 10% zinc, 20% nickel
Copper Nickel installed Jan., 32, 65% copper, 5% zinc, 30% nickel
Aluminum Nickel installed Jan. '32, 95% copper, 5% aluminum
Yorcalbro installed July, '31, 76% copper, 22% zinc, 2% aluminum
Admiralty installed July, '31, 70% copper, 29% zinc, 1% tin

Water-Metering Practice

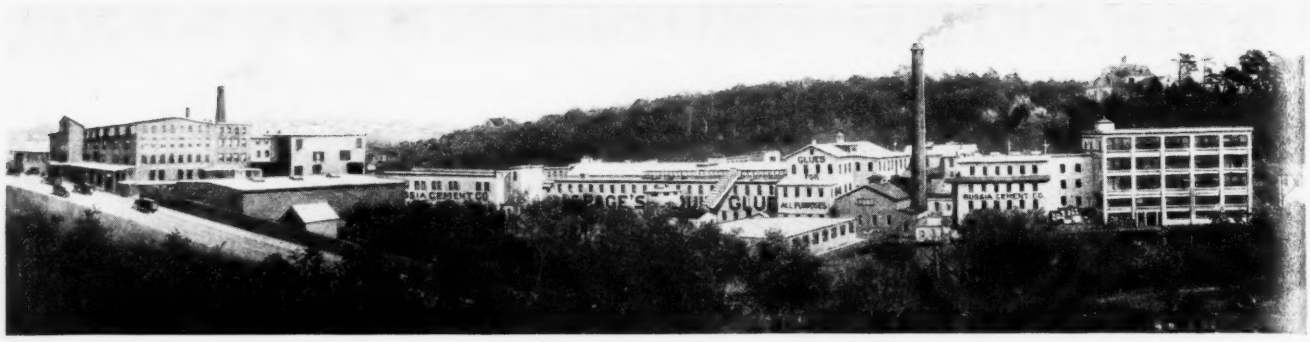
City water used in the gas and electric generating plants is taken through two 10-in. water service pipes normally connected at the street and in the plant. City bills for water are based on the sum of the registration of two 6-in. turbine-type master meters, one in each service pipe at the plant entrance. There was a monthly discrepancy between the registration of the two master meters and eight subsidiary meters which register plant consumption for accounting purposes. City billings averaged 12% higher than the consumption as determined from the subsidiary meters.

The first move to correct the situation was to advise the city that its bills were 12% too high. The city replaced one turbine meter with a compound meter which registers small consumption on a small displacement element, and automatically cuts in a turbine-type element for large usage, but the discrepancy still continued. A careful search was made for leaks and the piping put in first-class condition. All subsidiary meters were examined and sent to the manufacturers for overhaul or replacement. Where possible, displacement meters were used for subsidiary metering, compound meters otherwise. When the program of tests and overhaul was finished, the discrepancy was still present.

We then tested the 6-in. turbine-type city master meter, which registered 90% of the water billed, because of its lower resistance to water flow and found it to be 12% fast. It was replaced by a compound meter duplicating the other master meter. During the last 2.5 yr., the respective aggregate registration of master meters and of the subsidiaries have agreed within 5% and frequently within 2%. An incidental benefit of this study was a substantial saving in the use of city water by various expedients, as each was analyzed to effect economies.



*Abstract of paper presented before New England System Operators' Club.



"LIFE BEGINS AT FIFTY"

For Russia Cement Company's Power Plant

By Alonzo B. Reed

Consulting Engineer,
Boston, Mass.

Le Page's glue, Signet inks, and associated products have for years been produced by a steam-engine-driven plant. Modernization reduced purchased power costs 85%, fuel costs 17%

RUSSIA Cement Co., Gloucester, Mass., manufacturer of Le Page's glue, Signet ink, gelatine pastes, gums, dextrines and adhesives, completely renovated its power generation and distribution equipment during the past year. This company was formed in 1880 when steam engines were the only available sources of power. Although boiler equipment has been replaced twice within the past fifty years, some of the original steam engines were still in service until early in 1934. The first d.c. generators and motors were installed about 25 years ago and the first a.c. motors (using purchased power) about eight years ago.

The original factory was provided with power from a 14x36-in. double Putnam engine. It was in constant service for over fifty years and operated up to the time it was removed to make room for the new steam turbine. Power from this engine was transmitted by belting, shafting and rope drive to machinery in the original factory and adjacent buildings. As the plants grew, additional engines were installed for main drives and for auxiliary drives on centrifugal pumps and other smaller equipment. Because exhaust steam contained cylinder oil, and because of its low pressure, it was not feasible to use it for manufacturing. During the heating season, some of the exhaust steam was used for factory heating and exhaust from the Putnam engines was also partially used for boiler feedwater heating, but the greater part of the exhaust was lost to atmosphere.

In addition to the main steam engines, there are two 30-kw., direct-connected engine-generators which furnish 115-volt d.c. current to small fractional-horsepower motors throughout the plant. Practically all of these motors are attached to or built into manufacturing machinery. Because of the cost of replacing these motors with a.c. motors and the loss of production which would result, it was decided to retain the present d.c. system and install a new 50-kw. d.c. generator driven by the new steam turbine and furnishing excitation for the main a.c. generator.

The boiler plant contained three water-tube boilers, two being 3,000-sq.ft. Heine boilers, one fired by hand and the other by an overfeed stoker. These boilers are not permitted to operate at more than 100 lb. pressure. The third boiler is a 4,150-sq.ft., cross-drum, Edge Moor boiler fired by a 5-retort Taylor stoker. Very satisfactory economies are being obtained from this unit. Steam is generated at minimum cost. Furnace-draft conditions are automatically controlled by a regulator which automatically adjusts the uptake damper and controls the speed of the forced-draft fan. This boiler operates at 215 lb. pressure, supplying saturated steam to the turbine throttle at 210 lb. Steam pumps, manufacturing and other processes that cannot operate at 215 lb. are served with steam at 90 lb. by Ruggles-Klingeman reducing valves.

The entire mill system was formerly operated at 90 lb. gage. The greater part of the steam was used for manufacturing, and these processes could readily operate with steam at approximately 45 lb. Piping had ample capacity to deliver steam at this lower pressure,

as these mains would not have to conduct steam to the old engines and pumps, which were to be removed as soon as the new power plant was in operation. This change in pressure would make it possible to obtain worthwhile amounts of low-cost byproduct power from process steam. Usually the manufacturing operations require large quantities of steam throughout the 24 hours of each day, which causes practically constant use for turbine exhaust. Occasionally, however, there is limited use for exhaust steam, and to prevent its loss during these periods it was decided to install a full-automatic extraction-condensing turbine-generator.

New Turbine

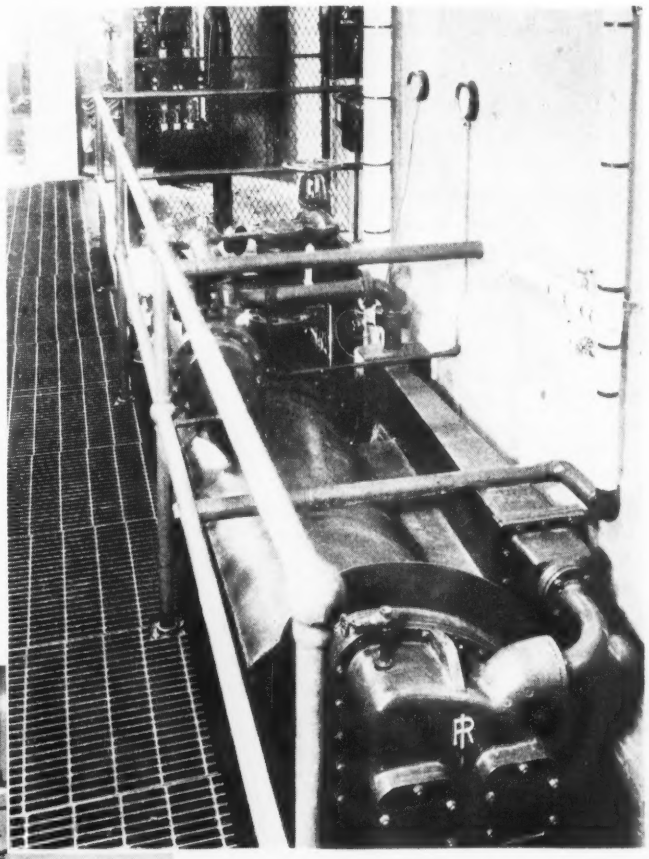
The new 300-kw. Moore turbine operates at 210 lb. pressure at the throttle, and steam is extracted at 45 lb. Exhaust is at 29 in. of vacuum. A vertical steam separator was placed in the steam supply line immediately ahead of the turbine, and tests show that this reduces the moisture content of the steam to $\frac{1}{2}$ to $\frac{5}{8}$%. Stainless-steel blading is used throughout the turbine. A 300-kw. alternator and 50-kw. d.c. generator are driven by the turbine through a 4,500 to 1,200-r.p.m. reduction gear.

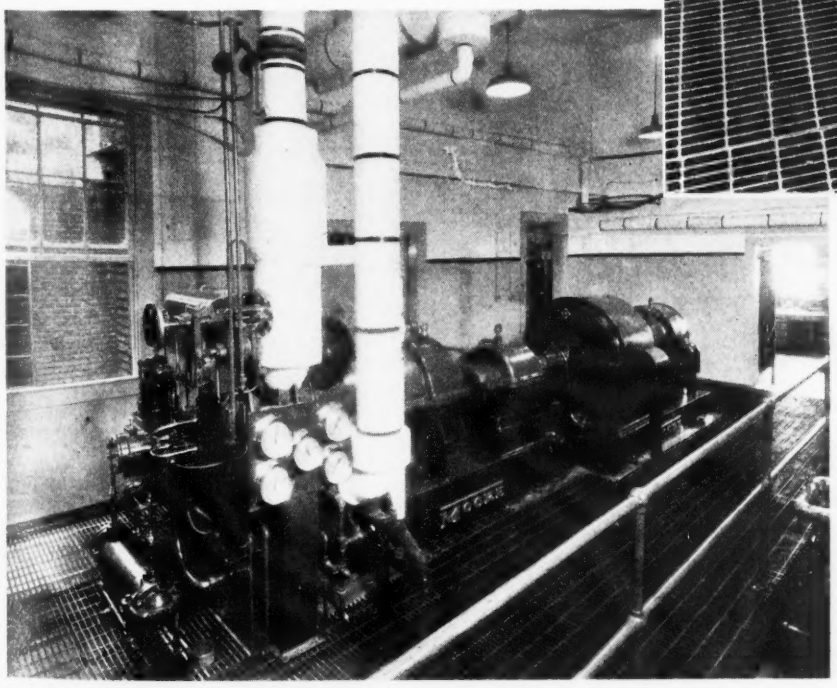
Should the turbine shut down or mill demand for 45-lb. process steam be greater than that which can be supplied through the turbine extraction valve, makeup steam is secured through a Swartwout master-control reducing valve set to operate at 43 lb.

Under normal operating conditions, the Bailey flowmeter, which measures all steam to the turbine throttle, registers an average of 8,000 lb. of steam per hr., 7,000 lb. extracted to the mill for manufacturing purposes and 1,000 lb. passing to the condenser.

Exhaust steam from the turbine is condensed by an Ingersoll-Rand Navy-type condenser equipped with air cooler and 2-nozzle dry-vacuum pump with inter- and after-condenser. It contains sufficient tube surface so that if necessary the turbine could be operated straight condensing at full 300-kw. load. Condensate is removed from the large condenser hotwell by a Warren duplex pump under control of a float in the hotwell. Condenser circulating water is taken from a fresh-water pond beside the power plant. After it passes through an 8-in. twin-type strainer, a motor-driven centrifugal pump circulates it through the condenser, through spray-pond nozzles and back to the fresh-water pond. The spray-pond cooling system is only used during extreme hot weather, at which time pond water reaches approximately 80 deg.

Space occupied by the new turbine and condenser was formerly occupied by a steam engine. There was a shallow basement below the engine-room floor, but due to ground water this basement could not be lowered materially. So it was impossible to put the condenser directly below the turbine. A concrete foundation supports the unit, and Blaw-Knox steel floor grating is supported by the edge of the turbine foundation and structural steel. This type of flooring was adopted to save headroom. The exhaust pipe from the turbine





Above—Welded condenser capable of handling full load, placed alongside the new turbine because of insufficient depth below

Left—Belts and line shafting driven by steam engine were replaced by this 300-kw. bleeder condensing turbine

runs horizontally below the steel floor grating and enters the side of the condenser.

A new 4-panel stretcher steel switchboard was installed properly to control and distribute electric current throughout the plant. An inter-locking circuit breaker permits going over to purchased power when necessary. The new alternator does not run in parallel with the central-station system. Entire load of the mill is carried by the new alternator, except for a few hours each week, when the turbine may be shut down and power purchased. The d.c. motors and lighting system at such times are supplied with current from either or both of the two 30-kw., direct-connected engine-generator sets. Each of the three d.c. machines may be operated separately or in parallel, thus permitting d.c. load to be transferred without interrupting service.

All power circuits are in conduit, and in departments where there is considerable water and moisture the conductors are lead-covered and the conduit system coated with acid-proof paint.

All new motors throughout the plant operate at 1,800 r.p.m., and were furnished by Louis Allis Co. Several of the individual machines and group drives operate at slow speed, obtained by Falk reduction gear units. These units eliminated the installation of a large number of belts, pulleys and countershafts. Due to moisture and dust, all motors are totally enclosed, and of the fan-cooled type. Individual motor drives are not universally adopted.

The steam and water piping installation was made by Lumsden & Van Stone Co., and Philip Carey pipe covering was applied by Installations, Inc.

Mill electrification and the new steam power plant were completed and placed in operation the latter part of June, 1934. Purchased power costs have been reduced 85%, fuel costs 17%.

WHAT ABOUT SMOKE ABATEMENT?

By Dr. O. P. Hood

Chief Mechanical Engineer,
U. S. Bureau of Mines

A GENERATION ago "smoke" was the visible output from a stack discharging products of combustion. It was usually described as some shade of black, light or dark, or dense, or only a haze. Complaints were largely against "dense black smoke," and "smoke abatement" meant the elimination of such smoke except for short periods of time.

Now "smoke" has a much more comprehensive meaning. It is being used to cover all undesirable material coming from a stack. In addition to the visible smoke of all shades, it includes the almost invisible ash and totally invisible harmful gas.

Amalgamated

The objective of "smoke abatement" requires that the threshold of quantities beyond which the air shall be considered impure shall be defined technically. Shall the determination of the amount of allowable impurity be determined by some technically defined limit beyond which damage is done to the person or to property, or shall we rest content with the simple statement "we do not like it," and arbitrarily declare it to be a nuisance? The technical man demands a technical definition. Now, there are practically no definitions technically sound or acceptable. The medical profession does not furnish a clear definition of what constitutes a harmful atmosphere except in very few things—for instance, the limit of allowable carbon monoxide in the air is pretty definitely determined.

This is the field of research and research requires long-time constant support. Temporary emergency effort over short periods can not help much, but it is in this field of research that the greatest good for smoke abatement can be accomplished, since definitions are necessary before a rational treatment of the subject can be had.

It may be that it is sufficient for the present to fall back upon a less rational basis of definition. It may be enough to simply say "we don't like it" and recognize the intuitive feeling as nature's way of self-protection. For the lack of a better basis at present we are compelled to recognize such an arbitrary basis for definition, so that we define "smoke" as something accompanying combustion that the community does not like and define "abatement" as the reduction of the amounts involved to the point where the community will accept it.

There is ample experience to show that the community will not pay an increased amount for fuel service for the single characteristic of smokelessness. Some individuals will pay but many individuals will not. If the use of a smokeless fuel is made compulsory for all it must be furnished at a cost for service no greater than that of a competing smoky fuel. This is the objective of all processed fuels, but so far has not been realized in any country.

Furthermore, any fuel can be burned smokelessly, so that it is unreasonable to give any one fuel a monopoly. The first requirement for complete combustion is that the equipment must be designed for the particular fuel used. Second, certain combustion conditions as to time, temperature and turbulence must be continuously maintained. Third, intelligent management and skilled operation must be constantly available. These three conditions are best met in large plants where coal burning is concentrated.

New large plants now being designed take the smoke problem seriously, and such plants are no longer main offenders. Not long ago such large plants gave the smoke problem scant consideration, so that the modernizing of old plants is good "smoke abatement."

Small industries, apartment houses, and domestic fires are now the main producers of smoke. Equipment used in these plants has not been designed for any one fuel but has always been a compromise, with cost the dominating factor. The same devices are still installed for any fuel from gas to high-volatile coal. To change this equipment would require assurance that a single type of fuel would always be available at minimum cost over a long period of time. To change all plants to new equipment would probably be prohibitive.

The third requirement for smokeless combustion is skilled operation and intelligent management. This is a matter of education and propaganda. It will not entirely solve the problem, but it will greatly reduce smoke and a part of it may produce permanent betterment. This is the best that can be done in the present state of the art with emergency funds. Statistical inquiry can be made to define present performance to which reference can later be made to measure the amount of improvement. This is a necessary part of smoke abatement and is also needed to allocate responsibility for smoke to guide technicians in methods of abatement and to justify expenditures by showing the amount of improvement. It is desirable to educate management in order that proper equipment and fuel shall be bought and that operation shall be effecitvely supervised and proper wages paid for skill. It is necessary to teach firing methods, to make known the facts of combustion, to further the use of effective devices, and oppose ineffective ones.

Electric Heat Controls Humidity

By George J. Kalwitz

American Foundry Equipment Co.

HEATING requirements of sugar warehouses are relatively small, it being necessary to heat only to control humidity. For this reason it appeared that electric heat would offer some advantages. An experimental installation was made in a 120 x 300-ft. sugar warehouse in Chicago.

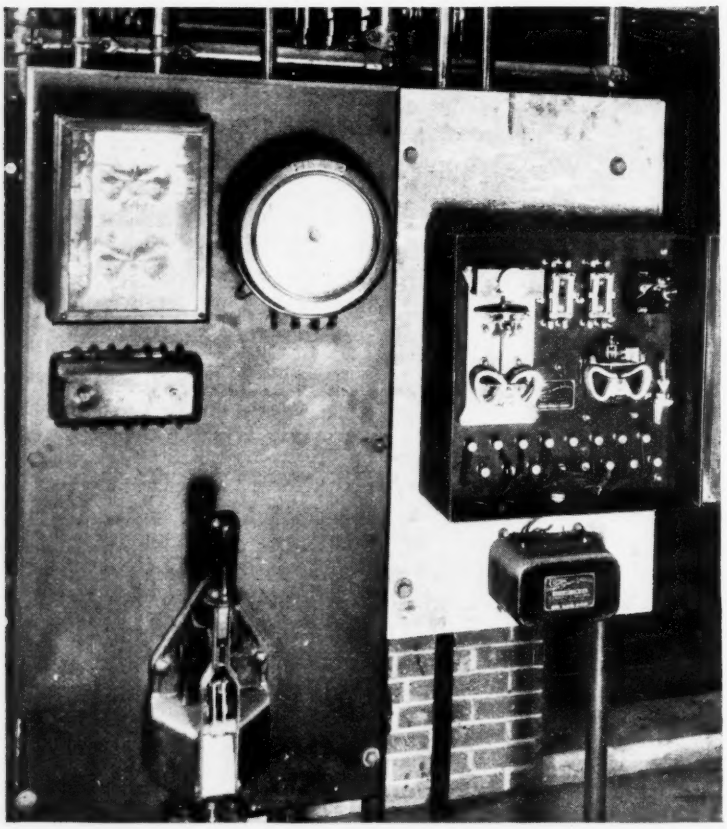
This installation consisted of four 12-kw. industrial electric unit heaters at equal intervals down the center of the building. The heaters were controlled by hygrostats set to turn on the heaters when relative humidity went above 65%. Large propeller fans were installed for better air agitation.

This temporary installation indicated clearly that in that area electric heat could be used successfully in this service at an operating cost comparable with that for other heat sources. In addition, the results enabled the warehouse to secure a large long-term storage contract provided a permanent installation of electric heating were made in another smaller warehouse of the same group. This warehouse is used to store bonded sugar, consequently the heating equipment can only be inspected when a government agent is present.

Five 6-kw., 3-phase, 220-volt industrial electric unit heaters were evenly spaced over the room, to be controlled by humidity conditions. 12,000-c.f.m. propeller fans were installed above each unit heater.

Unit heaters and fans are controlled by three hygrostats. The hygrostat controlling the two heaters and fans in the middle of the building is set so these heaters are first to operate, and are turned on when relative humidity goes above 62%. Two hygrostats at the ends of the building, one at the west end controlling one fan and heater, one at the east end controlling two fans and heaters, are set to operate the heating units at 67% R.H. Thus full effect of the two middle heaters is obtained before the three end units come into operation. This method of control was adopted to secure minimum "maximum demand" for electricity.

The warehouse was under lock and key for approximately four months, and inspections have been made at 3-week intervals. During Oct. 12 to Nov. 12, weather conditions were such that heat was required six different times. Although no meters were installed on the heating load, a liberal estimate of energy consumption was 1,200 kw.-hr., costing $63.25 net.



On the right the automatic demand limitator disconnects load in two steps if demand exceeds a predetermined amount.

WATCH MAXIMUM DEMAND

To Cut Power Costs

By John M. Acheson

Mechanical and Industrial Engineer, New York, N. Y.

Study your rate schedules and loads. A little checking may result in large savings to any industrial plants that buy power

IF YOU are responsible for electrical-equipment operation in a plant where electricity is purchased, become demand-minded. Educate yourself and your operators thoroughly regarding prevailing rate schedules and how maximum demand may materially increase power costs. Remember that a possible saving in using purchased power can very easily be dissipated through stipulations governing demand charges incorporated in rate schedules.

A demand charge in an electric rate schedule is intended to cover the utility company's fixed costs. The amount paid for power depends upon rates, usually approved by a public-service commission, and the monthly maximum demand measured at your plant over a 5-min. period or longer. The demand period stipulated in each rate schedule usually falls between 5 and 30 min., 15 min. being one of the most popular.

An unusually high maximum demand is often caused by one or a few peaks due to an abnormal, and perhaps unnecessary, condition. It is your job to prevent these unnecessary demands and thereby keep down power costs. As a pertinent example, a case in a southern factory which I surveyed will be cited.

Maximum demand recorded and billed by the utility was 260 kw. A recording demand meter was installed to determine factory load characteristics. This disclosed that at 7 a.m. each morning, full load came on and remained connected until 2 p.m., when it suddenly dropped off and by 4 p.m. reached a negligible amount. Further study disclosed a connected load of approximately 400 hp. in motors of $7\frac{1}{2}$ to 115-hp. capacity. In addition to motors essential for manufacturing and started at 6 a.m., a 115-hp. ammonia-compressor motor, a 20-hp. exciter, a 5-hp. deep-well pump motor, a 15-hp. brine-pump motor and a 30-hp. pulverizer were also started, resulting in a 260-kw. maximum demand.

We found that 155 hp. of refrigeration plant motors and the pulverizer could be operated during low-demand periods without interfering with production. To take advantage of this condition, the necessary production motors are now operated from 6 a.m. to 4:30 p.m. To prevent an overlapping of demands, the pulverizer is not started until 5 p.m. and continues in operation until 9 p.m. At 10 p.m., refrigeration equipment starts and is operated until 5:30 a.m. next morning.

Staggering the load in this manner reduced the maximum demand from 260 to 119 kw., a reduction of 141 kw. or approximately 54%. Demand charge is \$1.11 per kw., therefore a monthly saving of $141 \times \$1.11 = \$156.50$ resulted from reducing the maximum demand. Unfortunately, full advantage could not be taken of this saving immediately due to a clause in the rate schedules, which reads:

"By measurement of highest 30-min. interval monthly. The demand so determined shall be used as basis for the demand charge for such month, provided that the billing demand for any month shall not be less than seventy per cent (70%) of the highest demand established during any of the immediately preceding

twelve months, nor less than the contract minimum, nor less than 50 kw."

From this it can be seen that although the maximum demand under the new arrangement was 119 kw., a demand of 260 kw. had been established. Consequently, the best billing demand that could be obtained for the next 12 months was 70% of 260 or 182 kw., a reduction of only 78 instead of 141 kw. At the end of a year the established maximum demand of 119 kw. was granted. It is poor practice to establish a maximum demand before studying load conditions thoroughly.

To reduce a demand charge, it is necessary to know the cause of high peak loads. Where a rate schedule contains a demand charge the utility company usually installs a recording demand meter. Utility companies will generally cooperate with their customers and will give them photostatic copies of the demand-meter charts if they are requested. A better arrangement is for the power user to install a recording demand meter as a constant check on the load and the power company's meter. A recording high-quality demand meter can be purchased for about $150. With a reasonable amount of study of its records, the instrument should pay for itself many times over in reduction of demand charges. In the case previously mentioned the saving in demand charges for one month would pay for such a meter.

From the demand chart, the extent of the demand and time when it occurs can be determined. Study of manufacturing methods and equipment will show what is causing the high maximum demand and what can be done to reduce peak loads. Frequently the maximum demand occurs at the same time each day, as in the factory previously cited. An investigation of machinery used during that period will reveal whether or not operation of any part of the load can be delayed or advanced. Most plants have some equipment used periodically that can conveniently be in service during periods of low demand only.

Deferred Operation

Demand charges can be reduced in many ways, such as deferring operation of one or a few pieces of machinery. All electric motor loads should be carefully analyzed. If a load can be handled by a smaller motor than the one in use, the change will lower demand charges, increase efficiency, reduce energy consumption, and investment and improve power factor. Oversized motors, poor belt adjustments, dirty motors, unnecessary shafting, poor arrangement of machinery and improper lubrication frequently cause high demand charges.

Once the most economical maximum demand is established, some executive should see to it that instructions to keep the demand down to that amount are strictly followed. He should instruct everyone concerned on the proper sequence of operations and insist that his instructions are religiously followed, for one mistake may result in a penalty for twelve months afterward. Unless the importance of keeping demand down is brought to the attention of those responsible for motor operation periodically maximum demand is likely to show a sudden increase, resulting in increased power costs which might have been prevented by constant vigilance.

To emphasize the importance of being demand-minded, here are the demand charges of one rate schedule.

$2.10 per mo. per kw. for the first 200 kw. of maximum demand.

$1.60 per mo. per kw. for the next 300 kw. of maximum demand.

$1.40 per mo. per kw. for the next 500 kw. of maximum demand.

$1.25 per mo. per kw. for the excess, if any, over 1,000 kw. of maximum demand.

For example, assume a plant operating with a normal maximum demand of say 250 kw. Through carelessness, someone connects an additional load of 100 kw. for only a short period. Present monthly demand charge is:

200	kw.	at	$2.10	per	kw. =	$420.
50	kw.	at	$1.60	per	kw. =	80.
Total monthly demand charge =						$500.

But the short 350-kw. maximum-demand period creates a demand charge for 350 kw., which is:

200	kw.	at	$2.10	per	kw. =	$420.
150	kw.	at	$1.60	per	kw. =	240.
Total monthly demand charge =						$660.

This is an increase of $160 per month for twelve months unless superseded by a higher demand. It is evident that under such a rate schedule, carelessness in plant operation may be expensive.

Several devices are available for controlling maximum demand automatically, such as a polyphase wattmeter relay that gives an alarm when the demand reaches a predetermined amount. The operator can then reduce the load in time to prevent the demand exceeding the established limit. Equipment is available that will automatically disconnect part of the load temporarily without interfering with equipment essential for production, and thereby keep the demand down to a predetermined maximum.

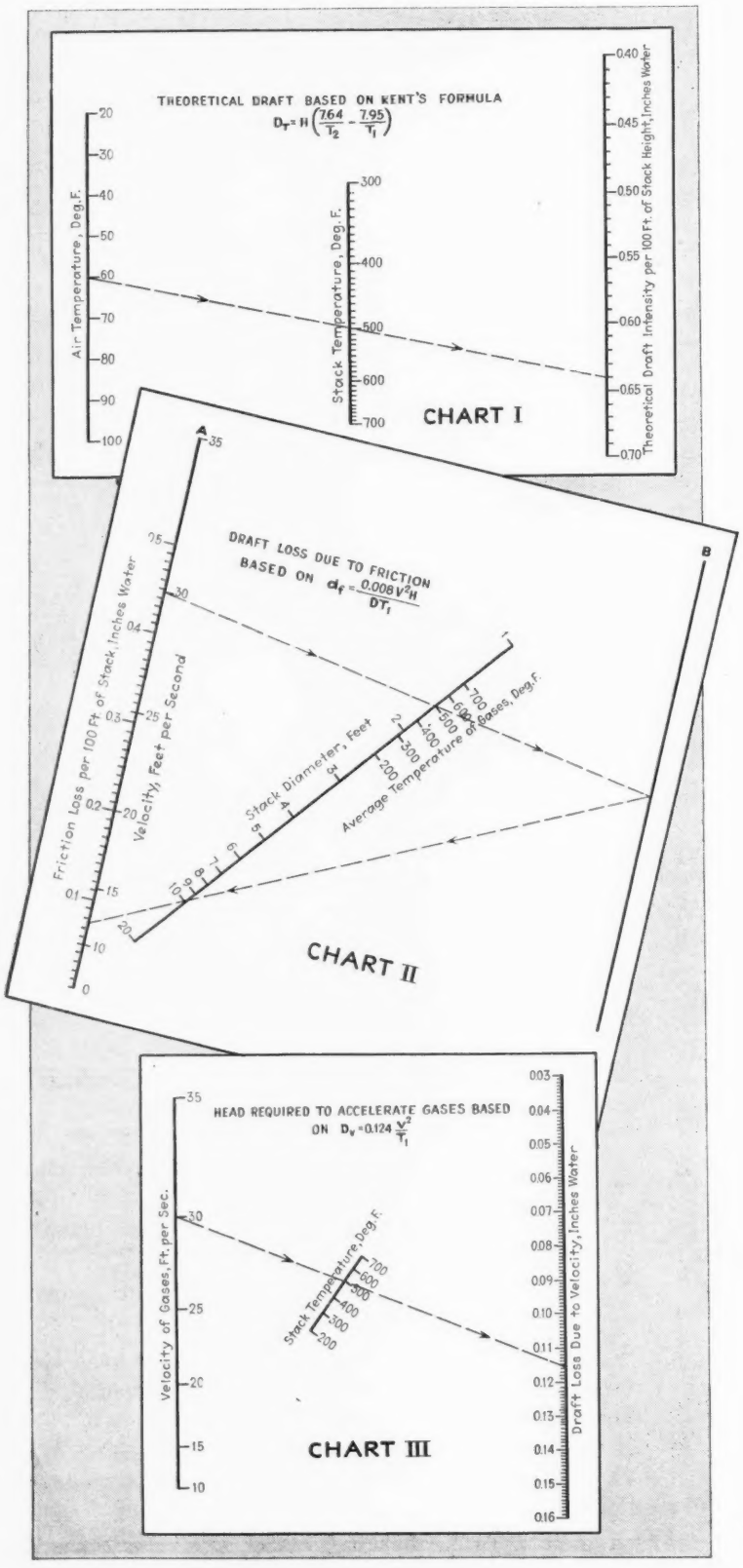
The executive responsible for power services should keep a record showing monthly meter readings, maximum demand, energy consumed and amount of the bills. With such a record available a continued increase in demand cannot occur without being detected, and proper action can be taken to correct the fault.

IF YOU BUY POWER:

1. Know the demand clause in your electric rate schedule.
2. Get demand charts showing the characteristics of your plant load.
3. Analyze the demand charts and operating methods to determine cause of maximum demand.
4. Stagger the load, if possible, to reduce peak loads.
5. Control demand automatically if necessary.
6. Instruct all operators regarding the proper schedule of motor operation.
7. Keep everlastingly at making everybody concerned "demand-minded."

POWER-PLANT CHIMNEYS

Here are three nomographic charts that give the answers in readily usable form.


THEORETICAL DRAFT BASED ON KENT'S FORMULA
$D_T = H\left(\frac{.764}{T_2} - \frac{.795}{T_1}\right)$
Air Temperature, Deg.F.
Stack Temperature, Deg.F.
Theoretical Draft Intensity per 100 Ft. of Stack Height, Inches Water
CHART I
DRAFT LOSS DUE TO FRICTION
BASED ON $d_f = \frac{0.008 V^2 H}{D T_1}$
Friction Loss per 100 Ft. of Stack, Inches Water
Velocity, Feet per Second
Stack Diameter, Feet
Average Temperature of Gases, Deg.F.
CHART II
HEAD REQUIRED TO ACCELERATE GASES BASED ON $D_v = 0.124 \frac{V^2}{T_1}$
Velocity of Gases, Ft. per Sec.
Stack Temperature, Deg.F.
Draft Loss Due to Velocity, Inches Water
CHART III

IT IS impossible to determine accurately all the factors influencing the size and height of a chimney, since certain assumptions must be made which will vary over a considerable range in practice. Moreover, the selection of the size best suited to the particular plant is in the final analysis more or less a "cut and try" process. The principles upon which the design of a chimney is based may be stated as follows:

1. The chimney must have sufficient cross-sectional area to handle gas without too great friction loss.
2. The chimney must be high enough to overcome all the losses expected in the plant it serves.

Theoretical draft intensity is given by the relation $D_t = 0.192H(D - d)$ where D_t = theoretical draft intensity, in. of water

H = height, ft.

D = density of air, lb. per cu. ft.

d = density of chimney gases, lb. per cu.ft.

Assuming an atmospheric pressure of 29.92 in. Hg, this formula reduces to

$$D_t = H\left(\frac{7.64}{T_2} - \frac{7.95}{T_1}\right)$$

where T_2 and T_1 are absolute temperatures.

Chart I is based on this relation and gives the theoretical draft intensity per 100 ft. of stack height. For an atmospheric temperature of 60 deg. F. and an average stack temperature of 500 deg., the result is obtained as follows: Using a straightedge, align point 60 on the air temperature scale with point 500 on the stack temperature scale. Draw a line connecting these points and continue it until it intersects the third scale. At this point of intersection read the theoretical draft intensity. For the given conditions it is 0.641 in. of water.

This theoretical draft intensity is not obtainable in practice, since it will be reduced by the draft loss due to friction.

Chart II is for determining this friction loss and is based on the relation:

$$D_t = \frac{fV^2H}{DT_1}$$

where f = coefficient of friction, which

—How High? What Diameter?

By Henry C. Oatley

for brick-lined stacks is usually taken as 0.008

V = velocity, ft. per sec.

H = height of chimney, ft.

D = diameter, ft.

T_1 = average absolute temperature chimney gases, deg. F.

Procedure in using this chart, which gives friction loss per 100 ft. of stack, is:

Given a velocity of 30 ft. per sec., average temperature of gases 500 deg., diameter of stack 10 ft. Align point 30 on the velocity scale with 500 on the temperature scale. Project this line until it intersects pivot scale B. From this point, draw a line through 10 on the diameter scale. At the point where this line intersects scale A read the friction loss. For the given conditions it is 0.075 in. of water.

Chart III is for determining the draft pressure necessary to give the gas velocity and is based on the relation:

$$D_v = \frac{0.124V^2}{T_1}$$

where V = velocity ft. per sec.

D_v = head, in. of water

T_1 = absolute chimney gas temperature, deg. F.

For a velocity of 30 ft. per sec. and a chimney gas temperature of 500 deg. the procedure is: Align point 30 on the velocity scale with point 500 on the temperature scale and project this line until it intersects the third scale. At this point of intersection read the amount of draft required to give the gas velocity. For the example shown this is 0.116 in. of water.

Design Procedure

The usual procedure in designing a chimney is to select a number of velocities, determine the corresponding height and diameter for each velocity and then select the most economical combination. Use of the three charts in facilitating these calculations may perhaps best be shown by the solution of a practical problem.

Required to design a chimney for the following conditions:

Average chimney gas temperature, deg. F.	500
Average atmospheric temperature, deg. F.	60
Draft loss through fuel bed, boiler, breeching and flue, in water	1.25
Maximum amount of gases to be carried off, lb. per sec.	100
Trial velocity, ft. per sec.	30

The first step in solving this problem is the determination of the chimney diameter necessary to carry off 100 lb. of gas per sec. at the velocity of 30 ft. per sec. This weight of gas will have a volume of

$$100 \times \frac{960}{41.4} = 2320 \text{ cu.ft. per sec.}$$

To obtain a velocity of 30 ft. per sec., stack diameter must be

$$\sqrt{\frac{2320}{0.7854 \times 30}} = 9.9 \text{ ft.}$$

The chimney must be of such height that the theoretical draft minus the friction loss in the chimney equals the draft loss through the fuel bed, boiler, breeching and flue, plus the draft required to accelerate the flue gas, thus: $D_t - D_f = D_1 + D_v$. By dividing $D_1 + D_v$ by the actual draft produced by a chimney 100 ft. high as found from the charts, the required chimney height can be found, thus:

$$H = \frac{D_1 + D_v}{0.641 - 0.075} \times 100 = \frac{1.25 + 0.116}{0.641 - 0.075} = 241.3 \text{ ft.}$$

A number of heights and diameters corresponding to assumed velocities can be computed in like manner and a final selection made upon the most economical dimension.

Yep, We Asked for It!

Do you know your power costs as accurately? If you do, we'd like to hear about it.—Ed.

ROGER SMITH HOTELS

NEW YORK EXECUTIVE OFFICE 501 LEXINGTON AVENUE, NEW YORK, N. Y.

Editor,
POWER
330 West 42nd Street
New York, New York

March 26, 1935

Dear Sir!

You asked for it (in your March, 1935, issue of POWER) and here it is! At any rate you should be amused, if not interested, to learn that, for the full year 1934, we averaged:

11,358 BTU per "cover" (i.e. meal) prepared in our kitchens whether by gas fuel, steam, or a combination. Incidentally those of our units using gas exclusively show less BTU consumption than those using other fuels in addition.

.0422 lbs. (Buckwheat No.1) coal per occupied room per degree-day during the eight heating-season months for heat and hot water.

16.1 cu. ft. of water per guest per day during the winter months, and 20.9 cu. ft. of water during the summer months. (That's a surprise, eh?)

3.57 KWH per occupied room per day during the winter months, and 7.34 KWH during the summer months; this being electricity for all purposes: ventilation, elevator operation, lighting, and probably to fire the electric stoves of such guests as cook their own breakfasts.

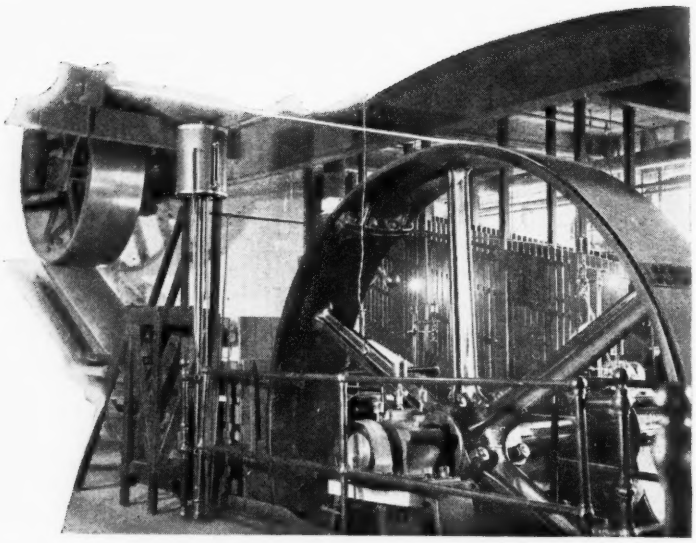
We can tell you how many rolls you'll eat for breakfast and once-in-how-often you'll ask for a second cup of coffee; but that isn't amusing even to us.

Very truly yours,
Roger Smith Hotels Corporation

O. A. de Lima
President

RUBBER BELTS

How Made, How Used and Where



A 24-in., 10-ply belt connects steam engine to line shaft. Pulley diameters 144 and 60 in. on 24-ft. centers

PROPER use of rubber belt assumes a knowledge of construction, limitations and load characteristics and how these affect belt dimensions for a given job. Among chief causes of unsatisfactory operation are selecting belts of improper construction for the pulleys on which they run and basing choice of belts on motor ratings rather than peak loads.

Rubber belting comprises layers (plys) of cotton duck impregnated with a slow-aging rubber compound. Cotton ducks of 24, 28, 32, 36 and 42 oz. weight are used. This represents the weight of a piece of dry duck 36 x 42 in. in area. 32-oz. duck is most commonly used in rubber belts.

The duck is first impregnated with slow-aging rubber compound, or "frictioned," the compound being forced into the duck by heavy pressure between calender rolls. The belt is made by folding the duck to give the desired width and number of plys. It is then vulcanized in a vulcanizing press. Many grades of rubber belts are made with raw edges, in which case there are no seams in the belt as in folded construction.

Belt "Friction"

The rubber compound in the duck serves two purposes. It seals the duck against moisture and fumes and binds the plys together into a homogeneous structure difficult to separate.

The force, measured in lb. per in. width of belt, required to separate one ply from another is known as the "friction" of the belt. A rubber belt is said to have 24-lb. friction when a pull of 24 lb. is required to separate a strip of one ply 1 in. wide from the belt, at a rate of 1 in. per min.

Most general-purpose rubber belting has frictioned surface only, that is, the only rubber in the belt is that put into the duck before the plys are put together. For special purposes, such as operation where steam, acid fumes or abrasive dusts are present, belts are made with a rubber covering. This covering provides a wearing surface to protect the fabric against severe conditions. Other special constructions include those having a layer of rubberized cords to take the load, laid parallel across the width of the belt. This produces an endless belt without a splice. The cords are imbedded in rubber and incased in a fabric envelope to take the wear. Belts of this type are for severe service, such as heavy shock loads and reverse bends.

In modern belts the material—fabric in rubber and leather in leather belts—is prestretched when the belts are made. As a result, present-day constructions require much less take-up in service than did earlier designs. A great many belts operate on short-centers, an idler being used, or the motor is mounted on a base that automatically maintains belt tension. In either case the tension-device take-up plus that obtained by shifting the motor on its base permits a belt to be operated without shortening during its life. This makes the use of factory-made endless belts desirable.

At one time practically the only endless rubber belts were those made endless in the factory. If they had to be shortened it was necessary to cut them and join their ends by some form of belt fastener. Methods are now available whereby rubber belts can be made endless readily in the field.

Rubber belts are made in thicknesses of from 2 to 15 plys and in widths of from 1 to 72 in. Above 10-ply, belts may be considered special for high-powered drives operating with large pulleys. It is desirable on any drive to use as thin a belt as possible consistent with a practical width. Table I shows pulley diameters recommended by one rubber-belt manufacturer and is fairly representative of those for standard lines of belting of other manufacturers.

Where smaller pulleys than those recommended in the table must be used, it is advisable to use a belt specially constructed for small pulleys. The smaller the pulleys, the more severe will be the bending stresses in the belt and the greater the tension required to transmit

Table I—Minimum Pulley Sizes Recommended

Plys	Belt Speed, Ft. Per Min. 1,000	2,000	3,000	4,000	5,000	6,000
3	3	3	4	4	5	5
4	4	5	5	6	7	8
5	7	7	8	9	10	12
6	10	12	14	14	16	18
7	14	16	18	20	22	24
8	18	20	24	26	28	32
9	24	28	30	34	36	40
10	30	34	38	40	44	48

Table II—Belt Sizes Usually Stocked By Rubber-Belt Manufacturers

Plys	Width In.	Plys	Width In.	Plys	Width In.	Plys	Width In.	Plys	Width In.
3	2	4	5	4	8	5	12	6	16
4	2	5	5	5	8	6	12	8	16
3	3	4	6	6	8	8	12	6	18
4	3	5	6	5	10	6	14	8	18
4	4	6	6	6	10	8	14	6	20
5	4	5	7	8	10	..	....	8	20

Table III—Power-Transmitting Qualities of Rubber and Leather Belts

Rubber Belt	Corresponding Leather Belt	Rubber Belt	Corresponding Leather Belt
3-ply.....	Light single	6-ply.....	Medium double
4-ply.....	Medium single	7-ply.....	Heavy double
5-ply.....	Heavy single or light double	8-ply.....	Medium triple
		9-ply.....	Heavy triple

Table IV — Horsepower Rating of Heavy Frictioned-Surface Rubber Belt, Based on 180 Deg. Arc of Contact

Size of Belt Width, In.	No. of Plys	Speed of Belt, ft. per min. 1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000
2	3	2.5	3.7	5	6.2	7.2	8.2	9	9.5	10
2	4	3.3	4.8	6.5	8.8	10.0	11	12	13	14
3	3	3.8	5.5	7.5	9.3	11	12	13	14	15
3	4	5	7.5	10	12	14	16	17	18	19
4	4	6.7	10	13	16	20	22	24	25	26
4	5	8.3	13	17	21	25	28	30	32	33
5	4	8.3	13	17	21	25	28	30	32	33
5	5	11	15	21	26	30	34	37	39	41
6	4	10	15	20	25	29	33	36	38	40
6	5	13	18	25	31	36	41	44	47	49
6	6	15	22	30	37	44	49	53	56	59
8	4	13	20	26	33	39	44	47	50	53
8	5	17	25	33	41	48	55	59	62	66
8	6	20	30	40	49	58	66	71	75	79
10	4	16	25	33	41	48	55	59	63	67
10	5	20	31	41	51	60	68	74	78	82
10	6	25	37	49	62	72	82	89	94	99
12	4	20	30	40	49	58	66	71	75	79
12	5	25	37	49	61	72	82	89	94	98
12	6	30	44	59	74	78	99	107	113	118
12	8	40	60	80	100	120	140	157	164	170
14	6	35	51	69	86	101	115	124	132	138
14	8	47	70	93	116	140	164	180	192	200
16	6	40	59	79	98	115	131	142	151	158
16	8	53	80	107	134	160	186	206	220	229
18	6	45	67	88	111	130	148	160	170	178
18	8	60	89	119	148	173	197	213	227	237
20	6	50	74	99	123	144	164	178	189	189
20	8	66	99	132	165	193	219	237	252	263
22	6	54	82	109	136	159	181	196	208	217
22	8	72	109	145	181	212	241	261	277	290
24	8	80	119	158	198	213	263	284	304	316

a given load. These conditions are conducive to short belt life and should be avoided whenever possible.

It is good practice to select a belt as wide as the pulley faces will permit. For narrow belts, pulleys should be at least 0.5 in. wider than the belt, for medium-width belts, pulleys should be at least 1 in. wider; for wide belts, 2 in. wider than the belt.

It is also good practice when selecting belts for a plant to standardize on as few sizes as possible consistent with good practice and to select those sizes usually stocked by belt manufacturers. Plant requirements can then be taken care of with a minimum of spare belting, and when new belting is ordered it will be readily obtainable. Table II gives the most commonly used belt sizes. Comparable sizes of leather belt should also be kept in mind when standardizing belting so that one may be readily interchanged with the other. Table III gives comparable ratings of a good line of rubber belting with leather of equal width.

Width and Plys

Recommended width and plys of heavy frictioned-surface standard rubber belting are shown in Table IV. A belt speed of between 3,000 and 4,000 ft. per min. on motor pulleys is usually most economical. As can be seen in the table, up to 4,000 ft. per min., centrifugal force has little effect upon belt rating. Below this speed, a belt's power-transmitting capacity increases almost directly with speed. Above 4,000 ft. per min., the belt's power rating begins to fall off quite rapidly. On large pulleys, such as engine flywheels belted to line shafting, a belt speed of 5,000 ft. per min. (in other words, a mile a minute) has been found economical. Because a high-speed belt is worked much harder than a slow-speed one, its maintenance and renewal costs usually will be higher, other conditions being equal. For the same reason a short belt will usually have a shorter life than a long one.

When a belt is selected always remember that load characteristics and starting method determine the horsepower of the belt that must be chosen and not the

A 75-hp., 1,750-r.p.m. gearmotor on a pivot base connected to its load by a 16-in. rubber belt operating on 9-ft. centers

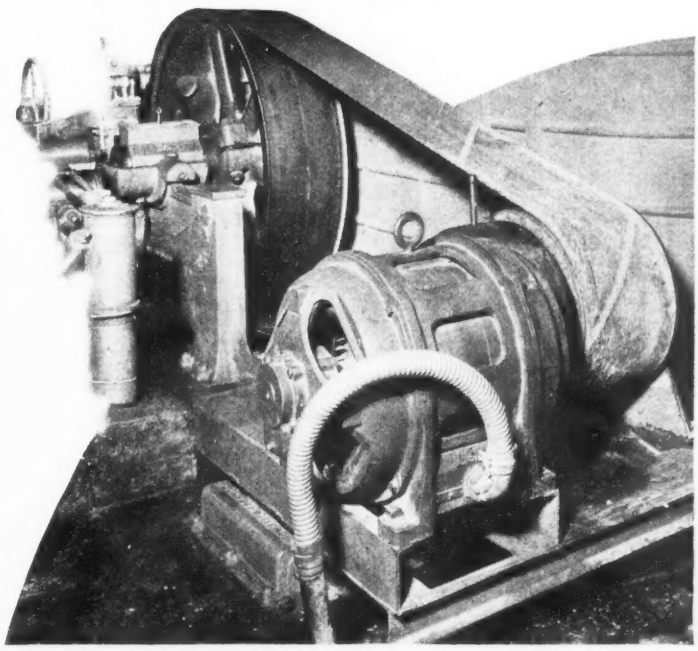


Table V—Service Factors by Which Normal Rating of Motors Must be Increased When Selecting Belts to connect them to Their Loads

Kind of Load	Typical Machinery	Service Factor
Starting load light—operating load normal	Small fans, blowers and centrifugal pumps	1
Light, pulsating—starting peaks 125% of normal	Small reciprocating pumps and compressors; lineshafts driving light loads	1.20
Moderate shocks or pulsations—starting peak loads 150% of normal	Reversing drives, large compressors and pumps, large fans and blowers, pulverizers	1.40
Severe shocks or pulsations—starting peak loads 200% of normal	Mining and smelting machinery, mud pumps, etc	1.75
Starting on peak loads up to 250% of normal	Textile machinery such as spinning frames and twisters, coal and similar conveyors	2
Severe shocks and stalling tendencies	Crushers, drag lines and other machinery driven by slip-ring motors	2
Motors started by connecting directly across the line; never less than		2

Table VI—Correction Factors for Arc of Contact

Arc of Contact Deg.	Correction Factor	Arc of Contact Deg.	Correction Factor	Arc of Contact Deg.	Correction Factor
180	1	160	1.08	140	1.18
170	1.04	150	1.13	130	1.23

rating of the motor. On most power applications a 10-hp. belt is not suited for connecting a 10-hp. motor to its load. For example, a belt coal-conveyor is stopped loaded and left standing all night in zero weather. If the conveyor is belt-driven by a 10-hp. wound-rotor motor, such a motor will develop at starting 300% full-load torque, equivalent to 30 hp. It will require all that and probably some human assistance on the belt to get the conveyor started. A 10-hp. belt is certainly not suited to such a job. A 20- or 25-hp. belt is needed.

Where induction motors are started by connecting them directly across the line, they will develop from 175 to 250% full-load torque, and this is applied to the belt as a sudden shock. For such applications, unless the belt has at least double motor capacity it is likely to slip and burn or come off the pulleys. Such difficulties may be avoided by using the service factors, Table V.

Assume a belt coal conveyor to be driven by a 20-hp. 1,150-r.p.m., slip-ring motor by belt. The motor pulley is 9 in. in diameter with a 9-in. face and connects to a 36-in. pulley on the conveyor, center-to-center distance being 12 ft. The service factor for such a drive in Table V is 2, that is, a belt normally good for 40-hp. when operated on 180-deg. arc of contact should be selected. Allowance must also be made for the arc of contact, which is less than 180 deg. The arc of contact of the smaller pulley may be found by the formula:

$$\text{Arc of contact} = 180 - \frac{60\ (D - d)}{C}$$

where D is diameter of large pulley and d diameter of small pulley, C center-to-center distance, all dimensions being in inches. Then:

$$\text{Arc of contact} = 180 - \frac{60 \times (36 - 9)}{144}$$

$= 169$ deg.

In Table VI, the correction factor for 170-deg. arc of contact is 1.04, which makes the rating of the belt to be selected equal to $40 \times 1.04 = 41.6$ hp. Belt speed in feet per minute is $S = (d\pi \times r.p.m.) \div 12 = (9 \times 3.1416 \times 1{,}150) \div 12 = 2{,}700$ ft. per min. From Table IV an 8-in., 5-ply belt at 2,500 ft. per min. will transmit 41 hp. and would be a good choice for the installation under consideration. It will allow 0.5 in. clearance on the pulley on each side of the belt. 5-ply is amply flexible for the pulley and the belt is a good standard size stocked by belt manufacturers.

When in doubt about the size of a belt, always err on the side of sufficient capacity. Ample-size belts operated with minimum tension without slipping will pay handsome dividends in increased belt life, uninterrupted service, and reduced maintenance cost of belts and bearings.

Information used in preparation of this article was supplied by B. F. Goodrich Rubber Co., Goodyear Tire & Rubber Co., U. S. Rubber Co., Manhattan Rubber Mfg. Co. and Rockwood Manufacturing Co.

H. P. FEED-PUMP OPERATION

By Harry M. Spring, Jr.

Brookline, Mass.

MANY features of high-pressure feedwater system operation are more or less puzzling when first experienced. Some jeopardize safe continuous service and should be avoided. A number of high-pressure steam plants use a system similar to Fig. 1. The number of extraction heaters, method of cascading drips and vents and type of drive for pumps vary to suit the particular installation; a typical system and valves are described.

Condensate from the hot-well is pumped to surge and storage tanks. A condensate pump takes water from the surge tank at 80 to 85 deg. F. and discharges through a low-pressure closed heater, evaporator condenser and vent condenser into the deaerating heater. Condensate entering the deaerating heater is at 130 to 180 deg. F., depending on plant load. This supply is controlled by deaerator water level acting on a float valve. When this valve is open and storage-tank water level is approaching a deficiency, the amount of make-up to the deaerator is increased by increasing evaporator

output. This causes deaerating-heater water level to rise, throttles the float-operated valve, and condensate gains in the storage system. When running at constant load, a balance is usually found through experience so that output of the evaporator will nearly equal the make-up required to maintain constant water level in the deaerator and storage system.

From the deaerating heater, feedwater is taken by a first-stage feed pump. Static pressure at suction of this pump is 30 lb. per sq.in., and temperature 195 to 265 deg. F. Discharge from this pump, at 350 to 700 lb., passes through a 3rd- and 4th-stage extraction heater, entering the suction of the 2nd-stage feed pump at 430 deg. F. full load. 4th-stage heater drips are pumped directly into the suction of the 2nd-stage feed pump. This pump discharges through the economizer to the 1,400-lb. boilers at from 1,500 to 1,700 lb. pressure.

Pump Drives

All pumps but the 1st-stage feed are driven by constant-speed squirrel-cage motors. It is operated by a wound-rotor, variable-speed motor. Speed control of this motor is the heart of the system. At high loads this motor drives the pump at a speed sufficient to give a suction pressure at the 2nd-stage pump high enough for it to operate at maximum capacity. At lower loads, boiler water level will rise if the 1st-stage pump is not slowed up. The rise in water level causes the feedwater regulators practically to close, which results in a feedwater pressure that will cause excessive cutting of the regulator valve and seat if the 1st-stage feed pump is not slowed down.

Operation of the 2nd-stage feed pump at constant speed depends on sufficient suction pressure at each temperature to prevent steam binding, which has occurred in some cases on low loads. When this happens, it must be corrected immediately or violent jarring of feedwater piping may cause serious damage. Until water temperature entering the 2nd-stage pump is reduced sufficiently to give satisfactory operation, the 4th-stage heater should be cut out by bypassing feedwater (open valve 4, close 2 and 3). The drip pump should be stopped and extraction valve closed. No. 3 heater is bypassed partially by opening valve 7 several turns. Discharge valve 1 of 2nd-stage feed pump is partially throttled if necessary.

4th-Stage Heater

Operation of the 4th-stage heater calls for great care. In the installation described, a compound turbine is used. The 4th-stage heater takes steam at 300-400 lb. pressure directly from the exhaust of the high-pressure turbine. If for any reason the drip pump fails, the extraction valve to this heater must be closed at once. Alarm signals should be attached to the heater draining system and be tested periodically. If the pump should stop unnoticed for a few minutes, heater condensate would rise and back up into the steam flow to the reheaters with serious results. On the other hand, if plant load is suddenly reduced and the heater goes empty the pump would be burned out in a very short time.

Due to the importance of the high-pressure drip pump and the temperature at which it runs, a tank was installed, Fig. 2, in one plant. The tank increased water capacity at the operating level of the heater. This gives a longer time in which to correct trouble, and more constant level is maintained in the heaters. An expansion-type regulator controls a bypass valve rather than operates the pump discharge valve. To do the latter might cause serious overheating of the pump. For normal operation, valves 2, 3, 4, 5, 6 and 7 are open and 1 is closed. Valves are provided so that the tank may be cut out of service if ever necessary for the making of repairs.

As the 1st-stage heater operates under a vacuum at times as high as 15 in. Hg., air leaks must be prevented to assure proper drainage. Drip-pump packing glands, valve stuffing boxes on steam lines to the heater, gage glasses and gaskets are all sources that may be the cause of such trouble.

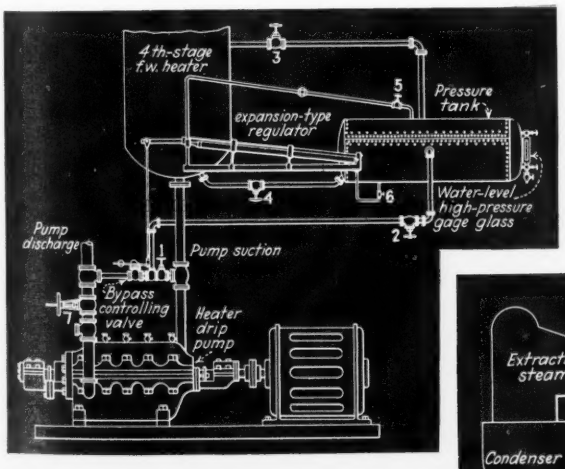


Fig. 2 (Above)—Storage tank added to 4th-stage feedwater heater

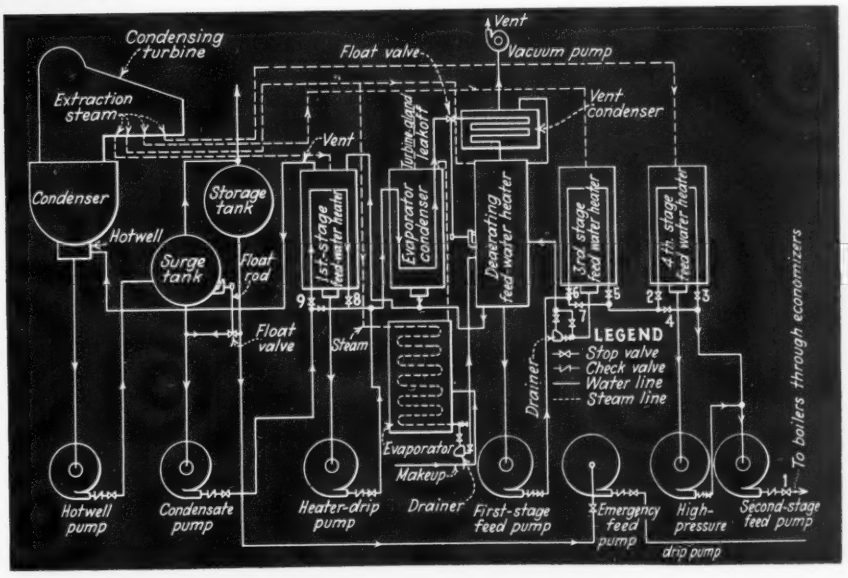


Fig. 1 (Right) — Feedwater heating system diagrammed for a high-pressure plant

LARGE-BOILER OPERATION

By E. H. Barry

Power Supervisor,
West Virginia Pulp & Paper Co.

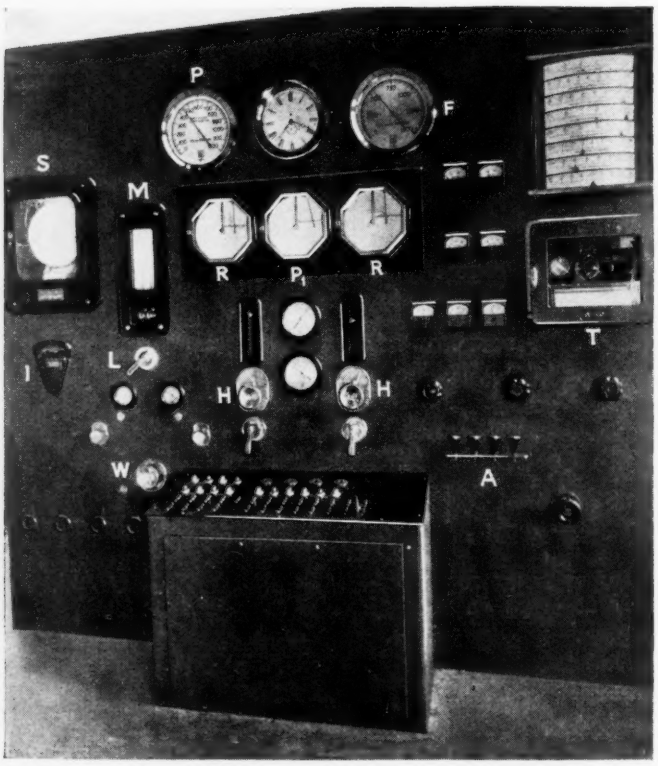


Fig. 1—On this panel board are centered all metering and automatic and manual control equipment for the boiler

COMBUSTION control equipment for the new boiler in the Covington, Va., plant of West Virginia Pulp & Paper Co., is a full-automatic system. This boiler is normally rated at 375,000 lb. of steam per hr. at 600 lb. gage and 750 deg. F. total temperature (see February *Power*, page 69). Boilers as large as this, even when manually operated, must be provided with centralized remote control. A full-automatic system can be provided at comparatively small additional cost. Load swings on this boiler are also such as to make full-automatic control desirable.

A system of interlocks in the auxiliary-motor controls provides protection against improper operation. Induced-draft and forced-draft fan and coal-pulverizer motor controls are so interlocked that an induced-draft fan must be running before the forced-draft fans and coal pulverizers can be started. A pulverizer must be running before its feed can be started. If the induced-draft fans stop, the rest of the combustion equipment is shut down. Stopping a pulverizer will automatically stop its feeder. (See April *Power*, page 192).

Complete control of the boiler is centralized on a panel board, Fig. 1. A booth on the back of this panel houses the master regulator, the regulators for draft, coal feed and furnace pressure, auxiliary equipment for the combustion-control system and automatic regulators for the high-pressure reducing valve and the desuperheater. This Smoot automatic-combustion control is designed to maintain a constant negative pressure in the furnace and vary fuel and air supply according to steam demands. It will also maintain a constant ratio between fuel and air at all boiler ratings.

Impulses from the master regulator to the fuel-feed and air-control regulators are transmitted by change in air pressure. Movement of the regulators and of the forced-and induced-draft fan vanes is by oil pressure. Fig. 2, gives the general arrangement of the control equipment. A master steam element has a spring-loaded diaphragm balanced against header steam pressure. This element controls the position of a bleed valve which regulates air pressure in the control lines to the diaphragms of the regulators controlling fuel-feed and forced-draft fan vanes. The air-pressure loading diaphragm of the fuel-feed regulator is balanced by the pull of a motor-driven oil governor, the speed of which is controlled by a field rheostat. On the draft regulator, air loading pressure is balanced against the differential pressure across the boiler and air heater.

A change in steam pressure causes the master regulator to reposition the bleed valve, which in turn changes loading on the fuel-feed and forced-draft regulators. This puts the regulator into operation to adjust fuel and air supply according to the new steam demand, until feeder speeds and air flow reach values corresponding to the new air-loading pressure. Fuel feed is changed by adjusting rheostats in series with the feeder-motor field windings.

Simultaneously with a change in forced draft, induced-draft-fan vanes are adjusted by the furnace-pressure regulator to maintain correct furnace pressure. The furnace-pressure regulator is independent of other control equipment and is caused to function by a change in furnace pressure, balanced against a dead weight.

The fuel-feed regulator acts directly on the feeder-motor and oil-governor-motor field rheostats back of the panel board. Combustion-air and furnace-pressure regulators open pilot valves to regulate pressure oil to servomotors that move the fan vanes. A restoring mechanism actuated by servomotor movement closes the pilot valves.

Ratio between fuel feed and air supply is indicated and recorded by a steam-flow air-flow meter and is adjusted by ratio valves on the master regulator mercury columns. Normally, fuel-air ratio is adjusted to hold the steam-flow air-flow pens together.

Control of the boiler may be changed from automatic to manual by throwing from right to left the handle on the throw-over valve, Fig. 2. This connects the fuel

GOES AUTOMATIC

Full-automatic and manual control is provided for all combustion equipment. Meters to give a complete picture of boiler operation are centered on a single panel board

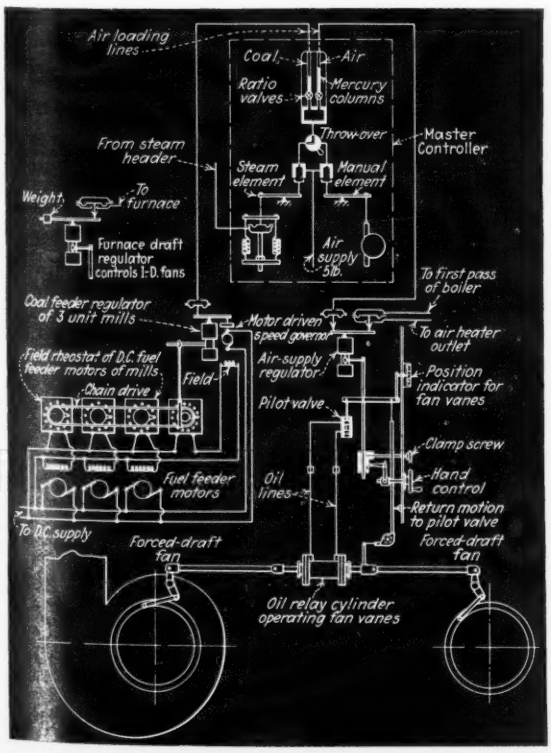
and air-control lines to the manually controlled bleed valve. Then bleed-valve position can be adjusted by turning a knob on the control-panel front to speed up or slow down boiler operation.

Position of the forced and induced-draft-fan vanes may be adjusted manually at any time regardless of whether the boiler is under automatic or manual control. Handwheels for doing this are at *H*, Fig. 1. Fan-vane position indicators are just above the handwheels, devices for connecting the handwheels to the control are directly below. At *M* are the mercury columns for fuel and air control of the master regulator. The ratio-adjusting valves are just below the columns, and *L* is the transfer lever for throwing from automatic to manual control by handwheel *W*. The four small gages show oil and air pressure available for the regulating and control equipment and *S* is the steam-flow air-flow meter.

Down on the left-hand side of the board are four knobs for opening and closing two forced-draft and two induced-draft fan-intake dampers. A fan's damper must be closed before its motor can be started, to insure starting with the fan unloaded.

On the bench board, the first four rows of buttons and lights on the left, are for starting and stopping the forced-draft and induced-draft fans. Two red lights are provided for each fan. One shows damper position, the other indicates if the fan is running. The next six rows of buttons and lights are for the three coal-pulverizer and three feed motors.

Fig. 2—Simplified diagram of combustion control equipment



Above the pulverizer and feeder lights are four sockets for the rotary switch handles, at *A*. These handles close switches that allow a forced-draft fan or a coal pulverizer to be started when the induced-draft fans are shut down, or a feeder can be started when its pulverizer is not running. To disconnect the handle, the switch must be open, and it is required that the switch handles be removed at all times except when the switch is closed. This insures against a bypass switch being left closed except when interlock protection is intentionally removed with the boiler out of service.

Buttons are also provided on the bench board for starting and stopping the pressure oil pump for the regulators, the fuel-oil pump and for stopping the alarm horn.

The three knobs just above switch handles *A* are on the field rheostats of the feeder motors. Position of these rheostats may be manually adjusted, since they are connected by friction clutches to the automatic regulator. The single knob just below and to the right of the switch handles is on the field rheostat of the fuel-regulator governor motor.

To know temperatures of combustion gas and steam is essential to efficient operation and has been provided for in 10-element recorder *T*. This meter records temperature of superheated steam, steam in header, desuperheated steam, boiler-room air, preheated air, gas leaving preheater, gas in the first pass, gas leaving boiler and gas in the intake to each induced-draft fan. Indicating meter *I* shows water flow to the boiler, meter *F* indicates feedwater pressure at the regulator and meters *R* record water level at each end of the boiler drum. Meters *P* and *P1* indicate and record steam pressure respectively.

The seven square ammeters to the right of the recorders indicate current taken by fan and pulverizer motors and show which motors are running. In the upper right-hand corner of the panel is an 8-point draft gage which indicates pressure in the furnace, secondary air duct, boiler exit, air-heater exit, outlet of forced-draft fans, entrance to each induced-draft fan, one being used as a spare.

From this panel board the operator puts the boiler on full-automatic or full-manual control at will. Any one function of combustion can be controlled independently of the others, and the meters give a complete picture of performance, allowing the boiler to be operated under practical test conditions at all times. Any variation, and the cause, is indicated to the operator, who then can immediately make necessary corrections.

DUST TAKES A HOLIDAY

When Filters Clean Conditioned Air

By R. B. Purdy
Associate Editor

IT HAS been said "There is no such thing as clean outdoor air." Perhaps those who live high in the Sierras may argue with such a statement, but city dwellers or those living near industrial centers will readily admit its truth. Outdoor air contains many dusts, smoke, pollen, bacteria, etc. Practically all are less than 0.0002 in. in size. In many industrial processes, clean air is necessary for quality products. In public buildings clean air is desirable for health and comfort. The cost can usually be justified alone by decreased cleaning required and protection against damage to costly decorations. Thus, most ventilating systems and all good air-conditioning systems include some kind of air-filtering device.

Filters for air conditioning and general ventilation are designed for relatively low dust concentrations. In cities, air dust loading runs about 0.4 to 0.8 grains per 1,000 cu.ft. In industrial centers, loadings of 0.8 to 2 grains per 1,000 cu.ft. may be encountered.

A number of types of filters are available. The accompanying tabulation shows the kind of filtering material, method of cleaning, resistance to air flow, capacity, face velocity and dimensions. Filters may be classified according to whether the filter material is dry or coated with a viscous (sticky) material, and whether of the throw-away, manually (hand) cleaned or automatic cleaning type.

Automatic-cleaning filters are relatively high in first cost, consequently intended for large-capacity installations where 50,000 c.f.m. or more air is to be filtered and use factor is high. Two filters of this type, for example, consist of a multiplicity of overlapping filter panels carried on endless chains and forming a filter medium 4 to 6 elements deep. The filter curtain is supported on sprockets over a reservoir containing a viscous oil. At intervals depending on the air dust loading, the sprockets are turned by motor and the dirty filter panels moved into and through the reservoir of oil, which cleans off the dirt and recoats the filter panels.

One automatic filter is of the dry type, arranged somewhat the same as the viscous units except that the filter curtain is driven past vacuum-cleaning nozzles.

After a period of use, resistance to air flow of automatic filters becomes constant. Viscous type filters should not be used when air carries any considerable quantity of lint, as this does not wash off and, unless removed by hand, gradually forms a mat which greatly increases resistance.

Non-automatic filters are made in units of convenient size for handling, usually 20 in. square or 16x25 in. By using a number of units, filters of almost any capacity can be installed to suit the space. Filters of this type cannot be forgotten after installation and still expected to give satisfactory or even passable results. The filter, if it is any good at all, will collect dust from the air. As it gradually becomes loaded, its resistance to air flow increases, resulting in a decrease in volume of air circulated or increased fan horsepower.

Manufacturers have expended considerable effort to make filter maintenance easy. One result is the cheap filter medium that can be thrown away when it becomes dirty and replaced with new material at low cost. Filters of this type include both dry and viscous-coated materials. The latter include mats of a coarse and a fine layer of split wire, glass wool held in fiber containers, and two layers of corrugated cardboard arranged so that the passages made by the corrugations are at 90 deg. to each other and at 45 deg. to entering air flow. The dry type of replaceable filter employs layers of cellulose paper, held between two screens and arranged to form pockets 2 ft. deep.

Other dry-type filters are arranged so they may be

AIR FILTER CHARACTERISTICS

Name	Filter Media	Cleaning Method	Air Resistance, in. H_2O		Capacity, c.f.m.	Face Velocity, f.p.m.	Dimensions of Unit
			Clean	Dirty			
Multi-Panel	Bakelite coated wire panel, viscous coated	Automatic	Avg.	0.35–0.45	2,600-up	500	1'1" deep, 5 to 13 ft. high, 2'7" and 4'11" wide
Airmat Pocket type	Cellulose, dry	Renewed, or vacuumed	0.18	0.35	1,500 900	300	2'3"x2'3"x2' and 16½"x2'3"x2'
Renu-Vent	Split wire mat, viscous coated	Replaced	0.17		800	300	20x20x3½"
Arco	Corrugated fibre board, viscous coated	Replaced	0.13	0.4	670 800 800	300	16"x20" 16'x25" 20x20"x1¼"
Staynew Multi-V Type	Dry cotton fabric over non-metallic gauze-like center	Vacuumed	0.18 0.16		800 1,200	300 430	20x20x4¼" 20x20x8¼"
Protectomotor	Dry	Vacuumed	0.25		800	300	20x20x6⅛"
Dustop	Glass wool, viscous coated	Filter replaced	0.25	0.36–0.40	800	300	20x20x4¼"
Coppus	Dry wool felt	Vacuum cleaned	0.25		1,000	360	20x20x6½"
Sommers	Hair glass, dry	Washed—hot water or solvents	0.08	0.4	700	250	16x25x1¾" 20x20x1¾"
Burt	Crimped wire viscous coated	Washed	0.02		1,000	400	20x20x5¼"
Burt	Jute fiber and cheese cloth, dry	Vacuumed	0.25		800	300	20x20x
Burt	Viscous and dry	Automatic	0.25		2,500-up	286	
Double Duty	Stamped steel plates viscous coated	Automatic			3,000-up		9'3" high
Zig-Zag	Fabric, dry	Replaced			800	300	20x20" 16x25"
Kompak	Dry cotton	Replaced	0.15		600		
Relay	Vegetable Fiber Viscous coated	Replaced	0.06		800	300	20x20x2" 16x25x2"

easily vacuum cleaned. One employs a wool-felt filter glove pulled over a wire frame, forming pockets 6½ in. deep. Another uses cotton fiber pressed and distributed on both sides of a gauze-like center which gives it strength. This medium is formed in V's and held in a fiberboard frame to make a shallow cell only 1 in. deep.

A dry-type filter arranged for washing either with hot water or solvents is made of "hair glass" held between galvanized-wire screens about 1¾ in. apart. The filter mat so formed may be used either flat or in V-shaped assemblies to give greater surface in a given face area.

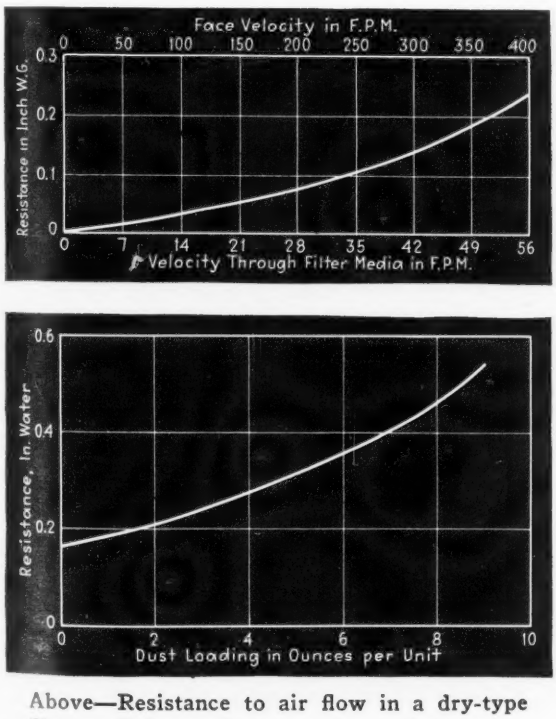
Several filters employ viscous-coated crimped wire held in a substantial metal frame and intended to be washed with hot water or steam.

Filter efficiency is rather difficult to determine and may vary over a wide range depending on the kind of dust or dirt that must be filtered. Air washers, for example, are reasonably good filters for certain dusts but it is generally admitted that they will not remove soot. Efficiencies claimed vary all the way from 80 to 100%.

Installation Pointers

In the ideal air-conditioning system, all air delivered should be filtered and the filters should be placed ahead of the air washer. This keeps the water used in the air washer clean, and it is less likely to become acid. In some instances, however, this degree of cleanliness is not necessary and filters are installed only in the air-washer bypass duct. In this way all of the air is filtered —some by the air washer, the rest by the filter.

When filters are installed in the air-washer bypass particular attention must be given to resistance of the filter as compared to resistance of the air washer. Obviously, if resistance of the filter is 0.4 in. of water and resistance through the air washer is 0.3 in. of water, more air will flow through the air washer than desired unless dampers in this part of the circuit are closed. This then imposes extra work on the fan which handles all air circulated. It must also be recognized that with all filters, except the automatic type, resistance is low when the filter is clean but increases as it becomes dirty. The dirty resistance should be considered when putting filters in air-washer bypasses, and when specifying the static pressure of the fan used with filters if full air supply is to be maintained between cleaning intervals.



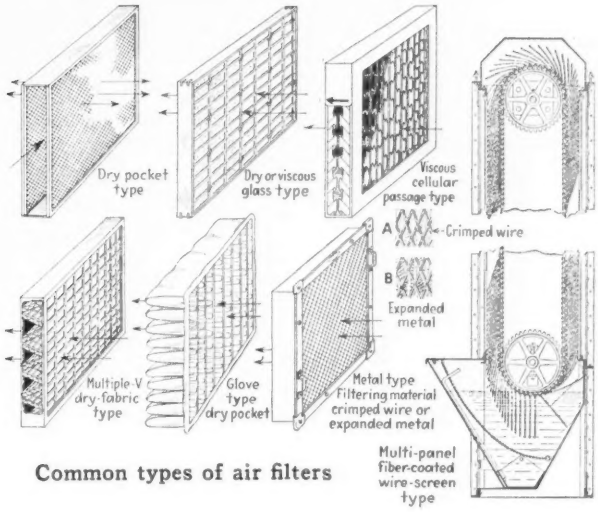
Above—Resistance to air flow in a dry-type filter. Below — Increase in resistance as viscous filter becomes dirty

Filters should not be called upon to handle very much more than rated capacity. If the filter is too small, increased dust loading due to greater air volume handled makes it necessary to clean or renew the filter more frequently. In addition, resistance of the filter is higher.

To avoid overloading some units of a large filter and underloading others it is necessary to secure even air distribution across the face of the filter. Best results are obtained when incoming air enters the filter chamber perpendicular to the filter. As normal air velocity in ducts is several times that required at the face of air filters, either the duct must be enlarged or filters installed diagonally in the duct. The first method will usually yield better results, provided the duct is enlarged gradually. Side angle should be not less than 45 deg., preferably 60 deg. Filters arranged diagonally frequently suffer from uneven distribution, as do high narrow or long low filters. When conditions require installation of this character, directing vanes should be employed to even out air flow as much as possible.

Space should be provided in front of and behind filters to permit inspection and servicing. At least 2 to 3 ft. should be provided in front of filters to give proper room for cleaning. Electric lights that can be switched on from outside the filter chamber should be installed. Differential draft gages should be provided to indicate resistance of the filters to air flow. These indicate when the filter needs cleaning. The following have contributed information to this article: American Air Filter Co., Inc., Burt Air Filter Corp., Coppus Engineering Corp., Independent Air Filter Co., American Radiator Co., Owens-Illinois Glass Co., Sommers Air Filter Sales Co., Staynew Filter Corp., W. R. Ripley Co.

No. 5 in a series. Earlier articles appeared in Nov. '34, and Feb., March and April of this year.



Common types of air filters

AUTOMATIC LANDING *with* Car-Switch Elevators

By M. S. Hill
Elevator Engineer,
New York, N. Y.

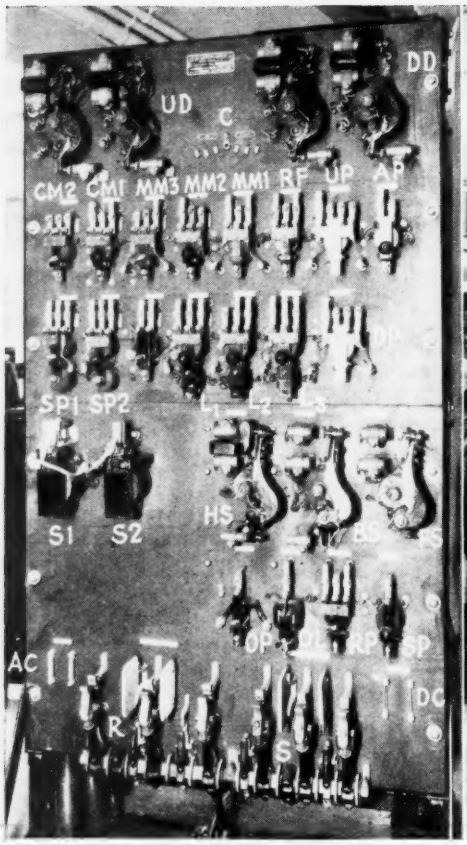


Fig. 1 — A. B. See Type *L-7A*, 2-speed control panel.

In Fig. 1—*UD*, up-direction switches; *DD*, down-direction switches; *C*, control switch contacts; *UP* up pilot; *AP*, auto pilot; *SP1*, speed-pilot No. 1; *SP2*, speed-pilot No. 2; *DP*, down pilot; *BS*, brake switch; *OL*, overload relay; *AC*, alternating-current fuses; *DC*, direct-current fuses; *R*, motor-running switch; *S*, motor-starting switch. The other contactors are clearly identified on the wiring diagram Fig. 3.

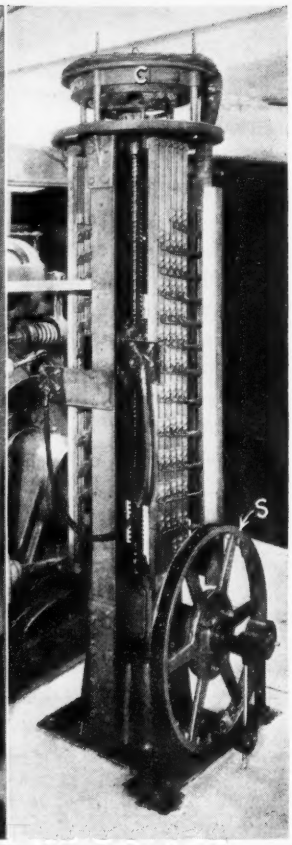


Fig. 2—Floor selector with tape driving wheel at *S*.

MANY types of automatic controls have been developed to stop elevator cars level with landings. Simpler ones function in connection with car-switch operation as does the A. B. See Type *L-7A*, 2-speed. The operator starts the car as with ordinary car-switch control. A flashlight system signals the operator when the car is approaching a floor where a waiting passenger has pressed a button for the direction in which the car is traveling. Then, if the car switch is centered the car will slow down automatically and stop level with the floor. When stopping for car passengers, the operator judges stopping distance and centers the car switch at the proper time, after which a stop is made automatically level with the floor. This control, although operating by car switch, relieves the operator of making floor stops.

The control panel, Fig. 1, is similar to that for standard variable-voltage operation. A floor-selector, Fig. 2, completes the floor-stopping circuit after the car switch is centered. It is driven from the car by a steel tape running over sheaves S. A circular commutator *C* atop the selector has one brush for up motion and another for down. The commutator segments are in series with selector contacts and act as a micrometer adjustment on the latter.

Fig. 3 diagrams the control equipment and for simplicity shows up-direction circuits. Contactors are identified on the diagram as on control panel, Fig. 1, and most contactors are shown complete but without some connecting wires. Contacts without wires will be found in their circuits elsewhere in the diagram, (this will become clear as the diagram is explained).

Motor-generator wiring connections appear at the top of the diagram. This set comprises a small squirrel-cage motor for starting, a large squirrel-cage motor for normal running, a direct-current generator and an exciter. Initial starting and stopping of the motor is from push button in the car.

Closing the car M.G. switch completes a circuit from line *A* through reverse-phase relay, M.G. switch in car, coil *S*, release-pilot contact B_1 run-switch contact *C*, overload-relay contact and to line *B*. The start switch closes its auxiliary contacts *A* and A_1 and a circuit to the starting motor. The motor-generator starts, and the exciter builds up voltage. Release-pilot coil *RP* and start-pilot coil *SP* are energized by the exciter, the former through release-pilot contact *B*, the latter through start-switch auxiliary contact *A*. Release-pilot coil, opens its contacts *B* and B_1 at about 75% exciter voltage, cuts resistance R_{77} in series with coil *RP* and transfers the start-coil circuit to contact A_1. Start-pilot coil *SP* closes its contact C_1 at nearly full speed of the start motor and completes a circuit for running-contactor coil *R*.

When the run switch closes, the main motor is energized, auxiliary contact *D* closes and *C* opens. The latter opens the start-motor contactor-coil circuit and this motor is disconnected. Closing contact *D* completes the running-contactor-coil circuit directly to the overload relay. Start-switch auxiliary contact *A* opens and releases start-pilot contact C_1. When the run switch pulls in, it closes auxiliary contact *F* and energizes the safety circuit. This circuit is from + on exciter through reverse field-switch coil *R*, door contacts, gate contacts, baby switch in the car, limit switches, counterweight, broken-tape and governor contacts, auxiliary contact *F* and to — line. The reverse-field switch closing completes direction-switch circuits when the car switch is moved to on position and opens its contacts *RF*. Contacts *RF* opening disconnects the generator shunt field from the elevator-motor armature.

Direction Contacts

Up-direction contacts only are shown for the car switch in the diagram. The three right-hand contacts are in the car switch, the three left-hand contacts on the control panel in motor room. Assume operation in up-direction. For slow-speed this circuit is from + line, through lower half of resistance R_{18}, contact *M* on switch MM_1, car-switch top contacts 1 and 2, up-direction switch coils, terminal-stopping switch *UR*, brake-switch coil, contact *L* on leveling

switch 3, reverse-field-switch center contact and through safety circuit to — line.

Energizing this circuit closes the brake and "up" switches. Brake circuit is from + on "up" switch, contacts B_1 on brake, brake coil and switch and to — "up" switch. When the brake releases, it opens contacts B_1 and connects resistances R_{32} and R_{33} in series with the brake coil, also closes contacts B_2. When + direction switch pulls in, it closes contact *UL* and completes a circuit directly to the car-switch top contact, making this circuit independent of resistance R_{18} and contactor MM_1. Coil MM_1 circuit is from + direction switch through direction-switch blow-out coil *BO*, MM_1 coil, direction-switch blow-out coil BO_1 and to — line. When MM_1 closes, it opens its top, and closes its bottom, contacts.

Amount of resistance in the generator series-field-coil circuit is controlled by contacts S_1 and S_2. Before S_1 and S_2 close, the generator and motor-armature are connected shunt. A circuit for S_1 coil with high-speed blow-out coil in series is directly from + to — direction-switch terminals. Energizing this circuit closes contact S_1 and completes the circuit through the generator series winding, overload-pilot coil *OP* and directly to the motor armature, with high-resistance grid *G* in parallel with the series winding.

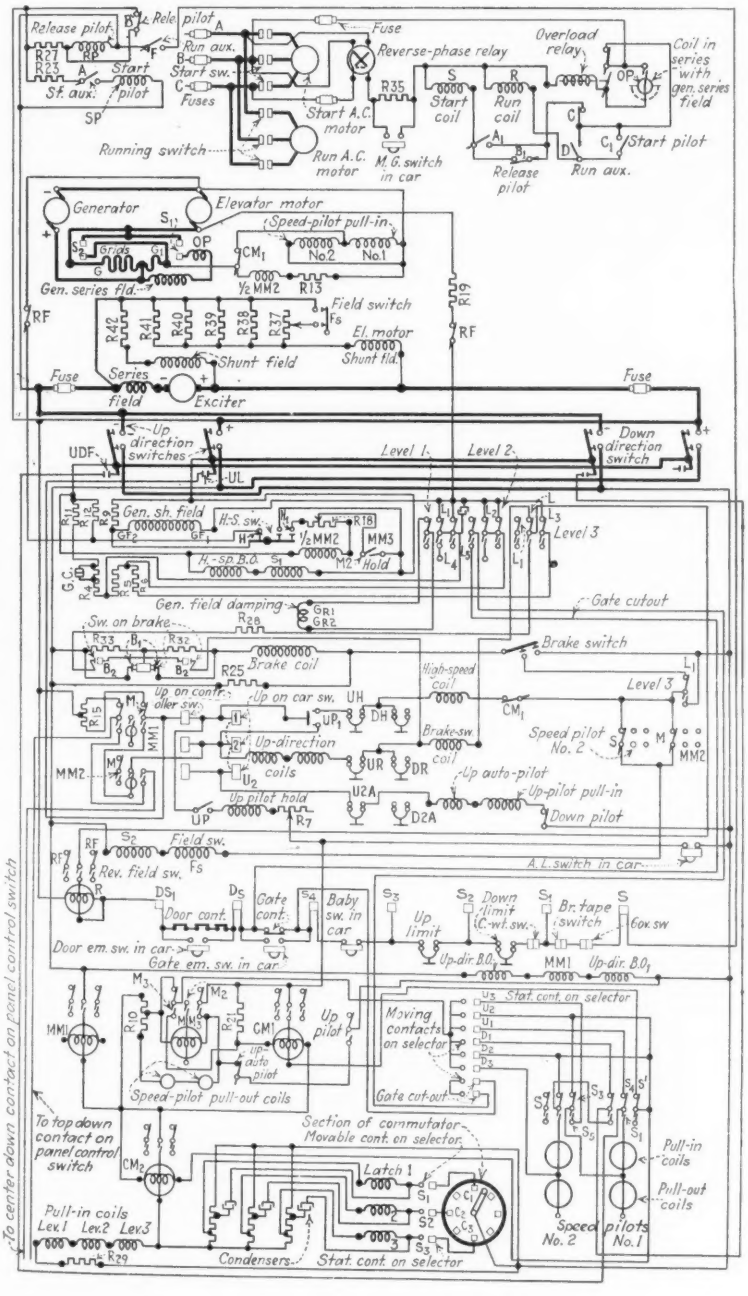
S_2 coil is in series with the elevator-motor shunt-field-switch coil *FS* and their circuit is from + direction switch through the two coils, contact *S* on speed-pilot switch No. 2, *M* on MM_2 contactor, L_1 on No. 3 leveling switch, the brake switch and to — line. Contact S_2 closes and puts low-resistance grid G_1 in parallel with generator series field. This gives a weak series field on the generator. Field switch *FS* closes and puts low resistance R_{37} in parallel with the elevator-motor shunt-field resistance and gives a strong motor shunt field.

The generator shunt-field circuit is from + direction switch, resistance R_9, generator-field winding, top contacts L_1 on leveling switch No. 1, part of R_4, R_{11} resistance, and to — direction switch, giving the generator a weak shunt field for first motor speed. Resistance R_{13} is shunted across the generator shunt field from GF_2 to contact *H* or high-speed switch to — line. This resistance helps to weaken the shunt field and also keeps that circuit closed during switching operations. As the field circuits are now established, the generator has a weak shunt and a series field and the elevator motor a strong shunt field, to give motor operation at low speed.

The motor-armature circuit is from + generator armature to between grid sections *G* and G_1, through *G* to motor armature, also G_1 and S_2 to the motor armature. A third branch is series-field coils, overload pilot coil *OP*, contact S_1 to motor armature and to — on the generator. The motor starts at slow speed with a strong torque. If the car switch is held on the first point, the motor will operate at slow speed. For high-speed, the car switch is moved to full-on and energizes U_2 contact, completing a circuit through terminal slow-down switch U_2A, up-auto-pilot coil, up-pilot pull-in coil, down-pilot contact and to — line. Making the up-pilot coil alive closes contacts *UP* and UP_1.

Contact *UP* closing completes a circuit for the up-pilot holding coil directly from the top contact of the operating switch through the up-pilot holding coil, resistance R_7 automatic leveling switch *AL* in car and to — line. Closing contacts UP_1 make a circuit to the first-speed contact on the car switch so it can be centered and control circuits remain alive. Opening the high-speed contact on the car switch will not open up-pilot contactor because the holding coil on this switch is alive from + side of the direction switch. Contact UP_1 closing also makes a circuit for the high-speed coil through stopping limit switch *UH*, high-speed coil, one top contact on switch CM_1, contact L_1 on leveling switch 3, brake switch and to — line. High-speed switch *HS* closes and cuts resistance R_9 out of the generator shunt field and disconnects shunt R_{12} from across this winding. Generator voltage increases and the elevator motor speeds up. The generator shunt-field circuit is from + direction switch to high-speed switch center-contact, generator-field-winding terminal GF_2, through this winding, part of R_4, R_{11} and to — line.

Fig. 3—Simplified diagram of an A. B. See Type *L-7A*, 2-speed control



Pilot Contactors

MM_2 contactor has two coils, one connected across the elevator-motor armature, from grid G_1, through resistance R_{13} and to — side of generator. Pull of this coil increases as motor-speed and voltage across its terminals increase. The other MM_2 coil is energized by closing of the high-speed switch, from H_1 contact, resistance R_{13}, coil MM_2 to — line. This causes MM_2 switch to close and opens contact *M* in S_2 and the field-switch-coil circuit, but this circuit is still complete through contact *S* on speed pilot No. 2 contactor.

Nos. 1 and 2 speed-pilot contactors pull-in coils are connected in parallel across the generator. The speed-pilot pull-in coil circuit is from grid G_1 through CM_1 contact to between the two coils, through the coils and to — on generator. These coils close their contactors

shortly after MM_2, first No. 1 and then No. 2. When speed pilot No. 2 closes, it opens contact S and breaks the S_2 and motor-field-switch coil circuit. S_3 contact opens the circuit through low-resistance grid G_1 in parallel with the generator series-field winding. This builds up generator voltage and motor speed increases. When motor-field switch FS opens, low resistance R_{37} is disconnected, and high resistances 38, 39, 40 and 41 remain in parallel and connected in series with the motor shunt-field winding. Generator field strength is increased, that of motor decreased, and the latter comes up to full speed.

To Stop the Car

To stop the car at a given floor from full speed, the car switch is centered 1.5 to 1.1 floors in advance. When the car-switch is centered, the circuit is broken through the up-auto pilot and up-pilot pull-in coils. The up-auto pilot contact is released and closes. The up-pilot contact is not released, being held closely by its holding coil. When the up-auto contact closes, it completes a circuit for coil MM_3 through the center contact of MM_1 switch, the top half of resistance R_{10}, MM_3 coil, the up-auto-pilot and up-pilot contacts and to — line. MM_3 contactor closes. When MM_1 contactor closed during starting, CM_1 coil was energized through resistance R_{31} and automatic leveling switch AL in car to — line, but its pull was not sufficient to close CM_1 contactor.

When MM_3 closes, its M_3 contact shunts R_{21}, making a circuit for coil CM_1 through M_3 contact to the selector traveling contacts, selector stationary contact U_3, speed-pilot No. 2 contact S_6, speed-pilot No. 1 contact S_1 and to — line. CM_1 closes its bottom contacts and opens its top contacts. One of the latter, in the high-speed-coil circuit, opens and cuts resistance R_9 in series and R_{12} in parallel with the generator shunt-field circuit, weakening it to slow-speed conditions. When the up-auto-pilot contact closed, it also completed a circuit for the speed-pilot pull-out coils through R_{10}, the speed-pilot pull-out coils, auto-pilot contact and to — line. Pull-in coils on the speed-pilot relays are energized and hold their bottom contacts closed until CM_1 switch closes and opens the circuit through them, when Nos. 1 and 2 speed-pilot bottom contacts open.

Opening the speed-pilot relays breaks CM_1 coil circuit through U_3 on the selector, but CM_1 contactor is held closed by a circuit through R_{21}. When speed-pilot No. 2 opens, it closes contact S in the S_3 and field-switch coil circuit. The field switch closes and puts low resistance R_{37} in parallel with elevator-motor shunt-field resistance. S_3 also closes and connects grid G_1 in parallel with the generator series field. These two operations bring the motor back to slow speed. When MM_3 closed contact M_2, it made a holding circuit for half of MM_3 coil through part of R_{18}, and MM_2 contactor remains closed after the high-speed switch opens.

When speed pilot No. 1 opened, a holding circuit was made for CM_2 coil through its S contact, the center contact of CM_1 and to — line. CM_2 closing makes, through its center contact, a circuit for the three leveling-switch coils in series, through resistance R_{29} and to — line. These switches are latched open and not released until the latch coils are energized when the commutator on the selector completes their circuits.

Latch-coil circuits are made alive up to the selector through CM_2 center contact. Latch coil No. 1 is energized by contact S_1 on the selector and C_1 on commutator closing. Leveling switch No. 1 is released and closes. It opens the circuit through the damping winding on the generator field poles, and flux in the pole pieces will respond more quickly to changes in field current. Contacts L_1 open and transfer generator-field circuit to leveling-switch No. 2 contacts L_2 and puts resistance R_8 in generator-field circuit. This weakens the generator field and causes further slowing of the motor.

No. 2 latch circuit is closed by closing of selector contact S_2 and commutator contacts C_2 when car is about 10 in. from the desired floor. No. 2 leveling contactor is released and closes, transferring the generator-field circuit to contact L_3 on leveling switch No. 3. This puts resistance R_5 and R_6 in series with generator shunt-field winding, weakening the field to slow down the motor to stopping speed. Contact L_5 on leveling switch No. 2 closes and short-circuits the gate contact through the selector when its gate contacts close. This allows the gate to be opened when the car is within a safe distance of the floor without interfering with normal stopping.

No. 3 leveling switch is released when its latch-coil circuit closes through contact S_3 on the selector and C_3 on the commutator. Closing of No. 3 leveling switch opens the generator-field circuit and causes dynamic braking by the motor to bring car to rest. No. 3 leveling switch also opens the brake-switch coil circuit through contact L_7 and the brake is applied, its coil being drained through resistances R_{25}, R_{28} and R_{32} in series. When the brake closes, it opens contacts B_2, interrupts the direction-switch-coil circuit, and these switches open. Opening the direction switches makes all the control circuit dead with the exception of the safety circuit, which is broken by opening the car gate. All contactors then resume normal dead position ready for the next start.

Selector Contacts

Selector contacts U_2 and U_1 come into operation on a 2-floor and 1-floor run respectively to provide a closing circuit for CM_1 coil. On a 2-floor run, speed-pilot No. 1 only closes, so that U_3 circuit of the selector is open through speed-pilot No. 2 S_6 contact. However, U_2 circuit of the selector is closed through contact S_3 on No. 2 speed-pilot contact S_1 of No. 1 speed pilot and to — line. Consequently, CM_1 contactor closes when U_3 makes on selector. On a 1-floor run, the speed pilots do not close and contactor CM_1 closes only after U_1 on the selector makes contact. This circuit is through S_4 contact of speed-pilot No. 1 to — line.

Should any switch in the safety-circuit open when the car is in motion, the reverse-field switch will drop out and the control switches will come to normal stop position. When the reverse-field switch opens, it connects the generator shunt field across the elevator motor when the high-speed switch opens. Motor potential is applied in reverse direction to normal on the generator shunt field coils and causes the field poles to be weakened quickly and reversed. This produces motor dynamic braking to assist the brake to stop the car in the shortest time with safety. With AL switch open, the control becomes non-automatic and the elevator is controlled entirely by car switch, except at terminal landings when the leveling switches open.

One governor contact is in the safety circuit, the other short-circuits part of R_4 resistance out of the generator shunt-field circuit. If the car starts to overspeed, governor contact GC will open first and put resistance R_4 in series with the generator shunt-field winding. If this does not bring the elevator under control and its speed continues to increase, the governor contact in the safety circuit will open and the elevator will be stopped as described in the preceding paragraph. Should the control fail to function and the elevator continue to overspeed, the governor would set the car safeties on the guide rails.

Bonus Based On 3-Month Performance

A BONUS system which I put in effect some time ago in a central station produced immediate results. Plant personnel was about 50, but it was realized that boiler-room efficiency is more dependent on the human element than any other department, and so the bonus system was applied only to the three water tenders and three firemen. There was also a relief fireman, while one of the firemen acted as a relief for the water tenders. The relief fireman was not included in the bonus because he worked on all shifts, but his salary was the same as that of the firemen, namely $115 a month. Water tenders' salaries were $160 a month.

The bonus system was based on a lump sum of $25 which was divided into three prizes for the water tenders and three for firemen. It was paid once every three months.

A 3-month period was used instead of monthly payments because the shifts were in rotation and the difference in efficiency due to load was equalized during this period. Incidentally, this had another advantage in that larger prizes could be given every three months than every month. Each man received a prize, the prizes being:

	Water tender	Fireman
First prize	$5	$10
Second prize	2	4
Third prize	2	2

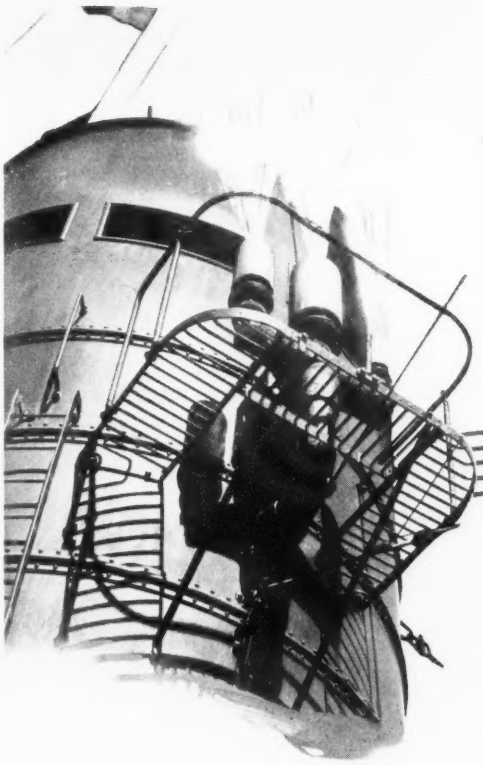
Records were kept of the steam generated and coal or other fuel consumed by each shift, and at the end of each 3-month period the evaporation for each group was determined and posted. Evaporations for the groups were close together, usually within 5%, showing that all the men put forth their best efforts. Boiler room efficiency was increased from an average of 82% to an average of 86% one month after the bonus was adopted, and was maintained for the year and a half I was with the concern.

This plant had an annual fuel bill of about $300,000, so the saving in fuel was $15,000, at least $10,000 as a result of the bonus plan.

Chicago, Ill. N. T. PEF

A QUEEN WHISTLES

And when she stops, the disk of the 3⅛-in. controlling poppet valve slams down on its seat. It used to leak after three days and fail in fourteen, which meant a couple of hours of work. But S.S. "Queen of Bermuda" has whistled trouble-free now for six months

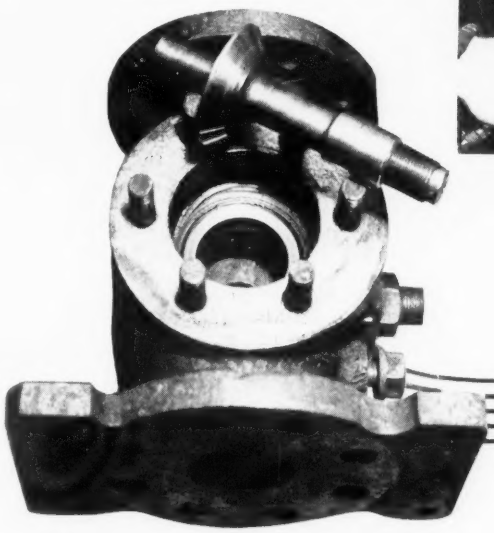


Slamming down under 375-lb., 590-deg. steam used to groove the disk like this in two weeks

Stelliting the disk with an oxy-acetylene blowpipe. ⅛ in. on seat and disk took 1 hr.

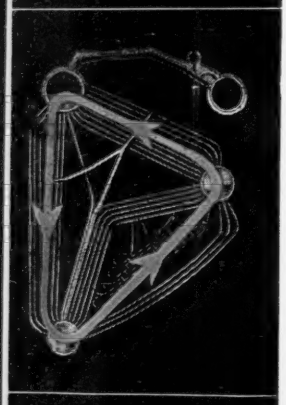
Stelliting the seat. It was then rough-ground on top, screwed in and bronze-welded to the C.I. steam chest to avoid leaks

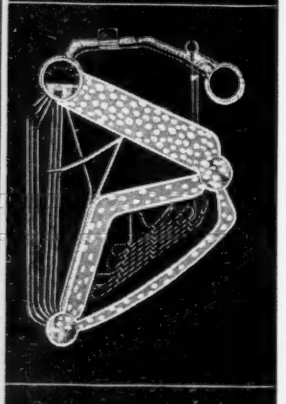
Lapped in with pumice, the hard-faced valve is ready to go back to sea

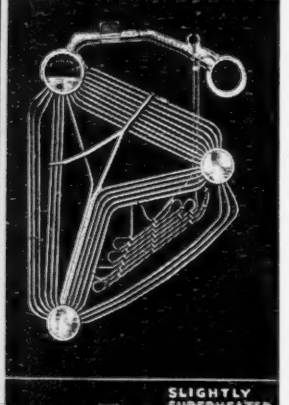


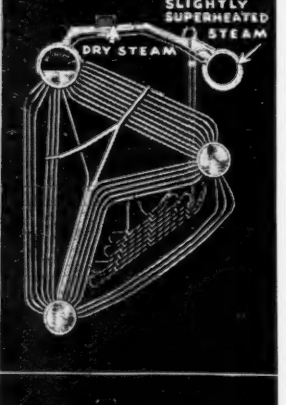
Stellited disk and seat ready for grinding, which took 2½ hr. with a Norton 3860 K5B wheel

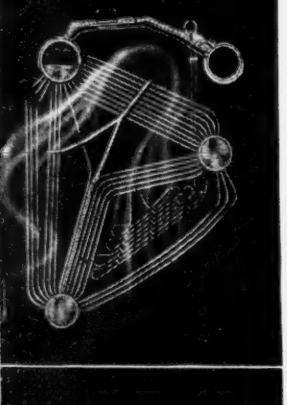
Work under direction of chief engineer, S.S. Queen of Bermuda. Furness-Bermuda Lines. Welding and grinding by Boro Valve & Brake Service Co., New York, under supervision of Frank Roth. Photos courtesy Haynes Stellite Co.











STEAM GENERATING UNITS

FORGING AHEAD TO NEW GOALS

Within a period of a few years, Riley has become undeniably one of the leaders of the boiler industry. Plant after plant has swung to Riley equipment. Sales of Riley Steam Generating Units have increased each year since 1931 despite general business conditions. Operating results from Riley equipment justify this progress!

These distinctive characteristics of Riley Units will carry Riley to even greater achievements

The design of the Riley Boiler is based on the Ring Flow Unidirectional principle of circulation

1 MINIMUM RESISTANCE TO CIRCULATION. The large areas provided through boiler tube banks reduce resistance to circulation to a minimum.

2 MAXIMUM FORCE PRODUCING CIRCULATION. All tubes exposed to high temperatures carry upward flow of water and steam bubbles. This direction effect together with the large head producing flow insures rapid, positive circulation in a fixed direction in all of the tubes, with a very definitely increasing rate of circulation as the steam output increases.

The rapid circulation resulting from the above characteristics, immediately removes all steam bubbles as formed, insuring proper intimate contact between water and tubes which, together with gas baffling of the most effective heat transfer results in low flue gas temperatures.

3 UNIFORM STEAM COLLECTION. The steam is uniformly collected at low velocity by the overcomer tubes evenly spaced over the entire length of the drum. It is apparent that uniform distribution of steam to all superheater tubes also results from this design.

4 DRY, SLIGHTLY SUPERHEATED STEAM. Overcomer tubes connecting the third and fourth drums entirely remove the slight residual moisture from the steam and deliver it dry and superheated 10 to 20 degrees F. to the fourth drum.

5 CROSS FLOW OF GASES OVER HEATING SURFACES. Riley Boilers are baffled so as to obtain cross flow of gases over the heating surfaces with most effective heat transfer resulting. Baffling is so arranged and gas passages so proportioned as to result in unusually low draft losses and minimum exit gas temperature. Careful consideration is also given to provision for easy access for inspection.

In addition to the above and other distinctive features of design, you are assured, when purchasing Riley Steam Generating Equipment, of the highest quality materials and workmanship both in manufacture and erection. Unusual satisfaction, high efficiency, continuity of operation, and low maintenance result from these plus values. A visit to some of the recent installations of Riley Steam Generating Units will make these plus values perfectly apparent to you. One-eighth-inch scale drawings of recent Riley installations will be gladly sent you upon request.

RILEY STOKER CORPORATION

WORCESTER, MASS.

BOSTON NEW YORK PHILADELPHIA PITTSBURGH BUFFALO CLEVELAND DETROIT TACOMA ST. LOUIS CINCINNATI HOUSTON
CHICAGO ST. PAUL KANSAS CITY LOS ANGELES JACKSON, MISS. DENVER ATLANTA EL PASO SALT LAKE CITY NEW ORLEANS

COMPLETE STEAM GENERATING UNITS

BOILERS - PULVERIZERS - BURNERS - STOKERS - SUPERHEATERS - AIR HEATERS
ECONOMIZERS-WATER-COOLED FURNACES-STEEL-CLAD SETTINGS-FLUE GAS SCRUBBERS

TRADE MARK Rx REGISTERED

RILEY

FORGING AHEAD TO NEW GOALS

The great progress made by the Riley Stoker Corporation in the boiler industry is a recognized fact. Engineers everywhere are talking about the many outstanding installations recently made by Riley and the remarkable results being obtained by these installations.

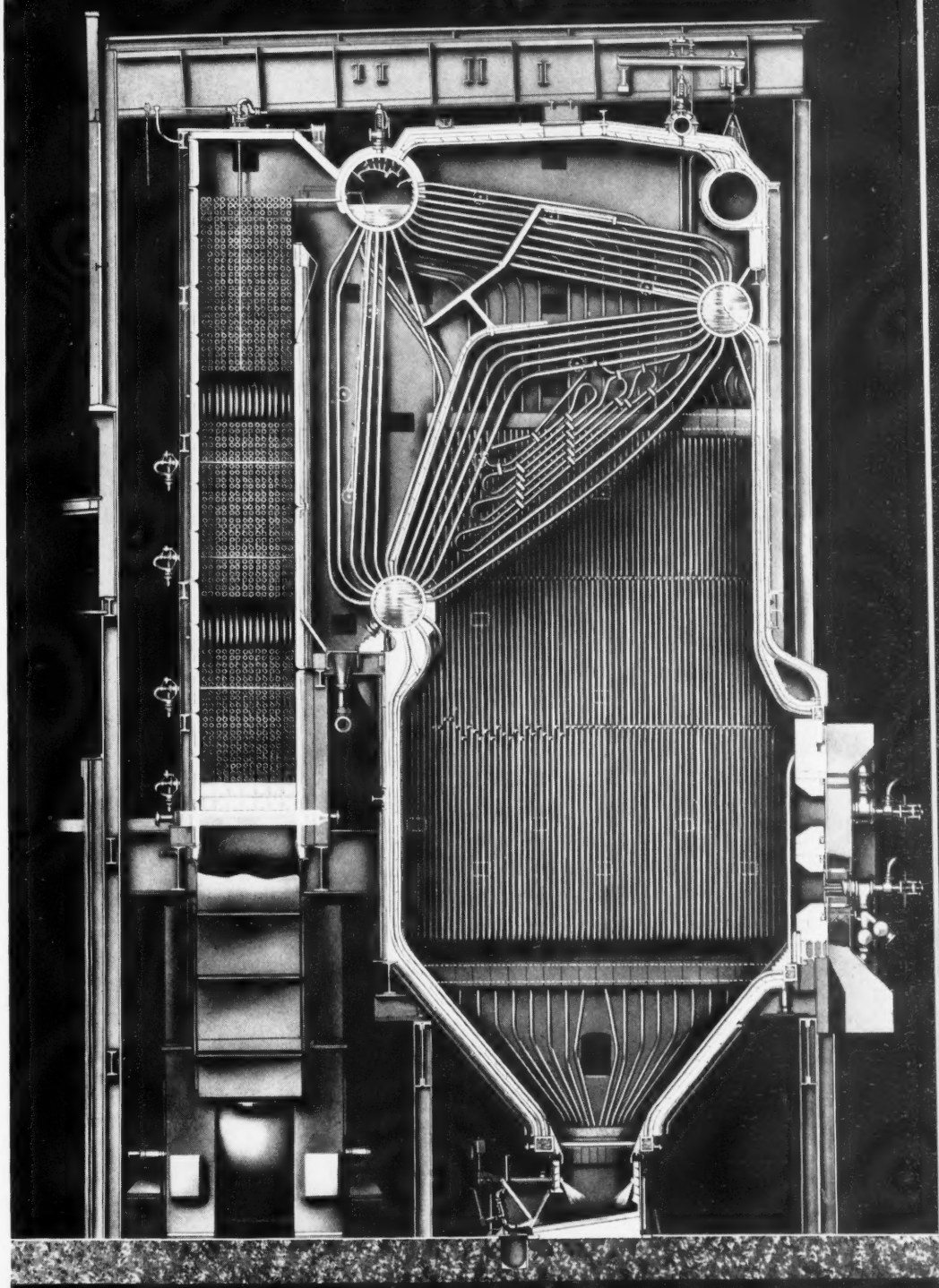
Plant after plant has selected Riley equipment. Real achievement commands recognition. The approval that the engineering profession has given Riley equipment spurs Riley engineers to greater achievements—to design and build better units each succeeding year. Riley is looking to the future, not living in the past.

This organization appreciates the recognition given to the merit of its products and will continue its progressive policy.

THE SWING **continues to RILEY**

A Few Recent 1935 Riley Orders

Carbide & Carbon Chemical Co.
Crystal Tissue Company
Worcester Polytechnic Institute
Charlton Woolen Company
Norton Company
Public Service Electric & Gas Co.
Papec Machine Co.
Shell Petroleum Corporation
Shantung Flour Mills (China)



RILEY STEAM GENERATING UNIT
INSTALLED AT A LARGE EASTERN OIL REFINERY
300,000 lbs. of Steam per hour—746 lbs. Pressure—740°F. Steam
A Typical Modern Riley Unit

RILEY STOKER CORPORATION

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER COOLED FURNACES • STEEL-CLAD SETTINGS • FLUE GAS SCRUBBERS

DIESEL MAINTENANCE LOGS

STATIONARY DIESEL MAINTENANCE SCHEDULE AND LOG

Station _____

Chief Engineer _____ Engine Number _____ From _____ to _____

Until experience shows a longer period is satisfactory, various engine parts should be inspected and necessary work done after the indicated number of months:	Cyl. No. 1	Cyl. No. 2	Cyl. No. 3	Cyl. No. 4	Cyl. No. 5	Cyl. No. 6	Compressor	Remarks
Main pistons taken out and cleaned....9								
Exhaust valves removed, cleaned and ground....3								
Air intake valves removed, cleaned and ground....6								
Fuel valves removed, cleaned and needles ground....3								
Air starting valves removed, cleaned and ground....3								
Safety valves removed, cleaned and ground....6								
HP air compressor valves removed, cleaned and ground....2								
IP and LP air compressor valves removed, cleaned and ground....3								
Fuel pump valves examined, cleaned and ground....6								
Fuel valve settings checked....1								
Cam roller setting checked every time valve cage is changed or cylinder head removed.								
Cam shaft gears examined....2								
Fuel pump driving mechanism examined....2								
Governors examined and adjusted....12								
HP compressor pistons disassembled, cleaned and examined....6								
LP and IP pistons removed, cleaned and examined....6								
Main and air compressor piston boxes examined and adjusted every time a piston is removed....Clearance (Before / After)								
Main and air compressor crankpin boxes examined and adjusted....6 (Before / After)								
Main bearing shells examined and clearance adjusted....12 (Before / After)								
Lubricating oil filters cleaned (clean filter bags every day)....3								
Lubricating oil holes in crankpins cleaned....6								
Lubricating oil piping cleaned out....1								
Lubricating oil supply piping and tank cleaned out....12								
Lubricating oil pumps cleaned out and examined....6								
Air-injection piping burned out for carbon....12								
Air cooler coils cleaned out for scale....12								
Main cylinder jackets and heads cleaned out for scale....12								
Valve gears examined and adjusted....3								
Main cylinder jacket space, main cylinder heads, compressor cylinder jackets space and head examined every time cylinder head is removed.								
Check clearance between piston and head every time air compressor or main pistons are removed.... (Before / After)								
Examine lubricating oil piping for loose joints and leaks....1								
Force-feed lubricator cleaned and examined....6								
Lubricating driving gears examined and cleaned....12								
Air receivers cleaned....12								
Crank shaft and extended shaft alignment checked....12								

This sheet lists approximate time intervals that should elapse before each of the various parts of stationary diesel should receive attention. Times given are probably from two to four times as short as will prove necessary in the usual plant, but until experience shows a longer time interval is satisfactory, follow this schedule. Vary this form as required to suit your particular plant, have it printed and make arrangements for systematic maintenance, so that each year all parts will have been examined and overhauled as is necessary. Half a dozen blank lines should be left at the bottom of the form for entry of other things than those given on the log. In the "Remarks" column, enter such remarks as may be necessary about the condition of various parts as they are found. Leave a blank space at the bottom of the sheet to note any troubles that may come up and what was done to remedy them. Send in a complete log sheet of this type occasionally to the engine manufacturer for his comments.

Courtesy McIntosh & Seymour Corp.

Here are two types of station logs, the upper suitable for any size plant, the lower for plants up to about 1,000 hp. The upper is made up as a full-page file sheet, the lower as a 3x5-in. card. Cost of parts, materials and time for maintenance and repairs should be recorded on the back of either type

Station No. _____
Engine No. _____

DIESEL MAINTENANCE LOG

Date:- From _____ To _____
No of Hours Actual Running for Interval Specified _____

Items to be Inspected	Recommended Max. Hours of Operation	Recommended Max. Elapsed Time Months	Date Work was Done: Cyl. No. 1	2	3	4	5	6	Remarks
Piston, taken out and cleaned	6000	12							
Exhaust valves, cleaned and ground	1500	6							
Inlet valves, cleaned and ground	1500	6							
Air starting check valves, cleaned and ground	4000	6							
Air starting valves, cleaned and ground	4000	6							
Fuel pumps, valves cleaned and ground	4000	9							
Spray valves, seat tightness each time engine is shut down	—	—							
Camshaft gears or chains, check and adjust if necessary	4000	—							
Governor, examined and adjusted	8000	—							
Wristpin bearing, checked and adjusted each time piston is removed	—	—							
Crankpin bearing, checked and adjusted	3000	—							
Main bearings, checked and adjusted, alignment checked whenever crankpin bearings are adjusted	8000	—							
Lubricating tanks, lines and passages cleaned	8000	12							
Lubricating piping, examined for leakage and loose joints	1500	2							
Lubricating oil filter, cleaned. Filter bags should be cleaned each shift	2000	3							
Lubricating oil pump, examined	4000	6							
Cylinder head jackets, examined and cleaned	750	—							
Cylinder jackets, examined and cleaned	4000	—							
Lubricating oil, exchange batches	750	—							
Crankcase, flush out	4000	—							

© POWER

DIESEL MAINTENANCE POINTERS

HERE are a few notes on operation and care of diesel engines to supplement the chart on the facing page:

MAIN PISTONS—When taken out and cleaned, remove rings and clean all carbon out of grooves. Clean pistons thoroughly with kerosene. Examine piston heads for possible cracks. Clean piston-pin oil holes. If ring is stuck, remove it carefully to avoid breakage, if time is available, using a curved piece of steel inserted under the ring. If time is short, break out the ring with a cold chisel. Put pistons back in the same relative positions; that is, keep the groove which supplies oil to the piston pin on the proper side of the cylinder so oil will be fed to it. Take care, when you put the connecting rod back in place, that it goes back the same way it came out.

EXHAUST VALVES—Adjust cam clearance when valve cage is replaced.

AIR INTAKE VALVES—Adjust cam roller clearance when valve cage is replaced.

FUEL VALVES—It is probable that grinding of the needle will not be required every three months. In any case, grind as seldom as possible.

AIR STARTING VALVES—Check cam roller clearance when valve cage is replaced.

AIR COMPRESSOR VALVES—Clean with soap suds. Remove carbon with copper or brass scraper. Grind in valves if they require it. If springs show effect of wear or heat, put in new springs. In replacing compressor valves, take care that the gasket under the seat is put in properly.

FUEL PUMP VALVES—When you examine them, clean if necessary and grind if necessary. Check up valve lifts and readjust if reground. Check clearance of the hand lifter.

CAMSHAFT GEARS—Examine to see if backlash is excessive. Check camshaft thrust bearing to see if camshaft end play is excessive. Thrust clearance should be adjusted to 0.003 in. Dowels in all gears should be tight. Check for proper lubrication.

FUEL PUMP DRIVING MECHANISM—Examine and adjust as necessary. Plunger stroke for all pumps should be the same.

GOVERNOR—Examine for loose links, bushings or spring connections. Check ball bearings. Renew any loose bushings.

COMPRESSOR PISTONS—Lift entire piston out for examination and cleaning when you take off the head. Clean just as recommended for main pistons.

Bearings

COMPRESSOR & MAIN PISTON BOXES—When a piston pin is removed and the rod taken out, put the pin in the box and determine clearance with a feeler or take leads in the usual way. Enter clearance in the log as found, also as it is after adjustment.

CRANKPIN BOXES—You can get an approximation of crankpin box clearance with a feeler. It is always best, however, to take leads to show the condition as found, and to show the condition after fitting up.

MAIN BEARING SHELLS—You can approximate bearing clearance with a feeler. However, take leads before and after fitting, and enter this in the log. Mark connecting-rod bolts and nuts and main bearing bolts and nuts and position of the nuts as found and after fitting entered in the log.

AIR COMPRESSOR CRANKPIN BOXES—See notes on main crankpin boxes.

LUBRICATING OIL FILTER—Clean all compartments and if possible boil out with soda.

LUBRICATING OIL HOLES IN CRANKPINS—Clean every time crankbox is removed.

LUBRICATING OIL PIPING—Blow out with air, then wash with kerosene, then blow out again with air. Disconnect pipe ends carefully so that no dirt will be blown into the bearing.

LUBRICATING OIL SUPPLY PIPING AND TANK—Blow out piping with air, wash with kerosene, then blow out again with air.

LUBRICATING OIL PUMPS—Examine check valves to make sure they are working properly and clean pump out. See that packing is in proper shape, and that piping connected to pump is secure.

AIR INJECTION PIPING—Take off a section at a time and heat with a blowtorch to burn out any accumulation of carbon. Then clean pipe out thoroughly.

AIR COOLER COILS—To remove carbon and oil deposited in the cooler by air, wash surfaces exposed to the air with Oakite solution, made by mixing 8 oz. of Oakite Platers Cleaner to 1 gal. of water. After carbon and grease have been dissolved, drain off and wash with water. Best results are obtained by boiling the solution with steam. Wash out surface of coils and casing in contact with cooling water with water to remove mud and sand, and fill cooler casing or coil with dilute solution of muriatic acid to remove any accumulation of hard scale. (Proportion, one part acid to ten water). This solution should be forced through the cooler until no more effervescence shows up. After acid has been used, the cooler should be washed out thoroughly, first with cold water, then hot.

Jackets

MAIN CYLINDER JACKETS AND HEADS—Wash out with water to remove mud and sand, then clean with solution of one part muriatic acid to ten parts water. Mix this solution in a barrel and disconnect jacket piping to one cylinder, and circulate the acid through the cylinder jackets with a hand pump. When all hard scale is removed, overflow will show no more evidence of effervescense or bubbling. Cylinder should then be washed out first with cold water, and then hot to remove acid. Hand hole covers should be removed and all loose scale scraped out. To clean cylinder head when off, plug holes in top of head, turn it upside down and fill level full with acid solution. When bubbles cease rising, if steam is available stick a steam hose into the solution and keep it up near the boiling point until no further evidence of activity is apparent. Then pump solution out of head, flush out first with cold water, then with hot, turn head right side up, remove handhole covers and scrape out thoroughly all remaining scale.

VALVE GEARS—Check to make sure that all keys and set screws are in place and secure. Clean up and free any corroded fits. If any pins or bushes show excessive clearance, renew. Clean out all oil holes.

MAIN CYLINDER JACKET SPACE, ETC.—Clean as much as possible in available time.

CLEARANCE SPACE BETWEEN PISTON AND HEAD—Check every time either connecting-rod box has been overhauled.

FORCED-FEED LUBRICATORS—Inspect operating gear, clean up oil compartments thoroughly and check up timing of feeds.

LUBRICATED DRIVING GEARS—Examine to make sure that keys are secure and working properly. Oil in cases should be renewed.

AIR RECEIVERS—Clean with Oakite solution as coolers are cleaned.

ALIGNMENT OF CRANK SHAFT AND EXTENDED SHAFTS—Do this when the piston is pulled. Remove main bearing caps and roll out lower shells one at a time, measure thickness of the shell on the bottom with a micrometer. Take thickness in three places on the bottom of each shell, one near the middle, one near each end, and at two places about halfway up the sides in the middle. This will give you a good idea of how much the various bearings are worn down and how much it has affected shaft alignment. Before removing shells and after all caps have been removed, give each shaft journal a very light coat of thin red lead. Then turn the shaft a couple of revolutions. If the shaft is not exactly true at any bearing, the journal will show a bearing only on one side. If the shaft is true and supported in the bearings, the journal will show a bearing all the way around. If the shaft is approximately true but gets no support in the bearing, the journal will show that it has not touched during the entire revolution.

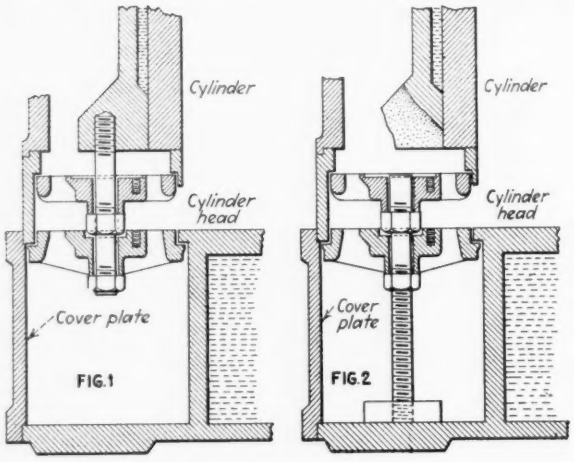
If any journal shows that the shaft is not exactly true at that point, the amount that it is out can be checked as follows: Roll out this shell, then from some fixed point in the frame above the shaft measure down with a micrometer to the shaft journal, getting this measurement while the nearest crankpin is at its upper and lower center, and also when this crankpin is halfway down and halfway up.

Bearing Alignment

Where fixed points can be arranged above each journal, alignment of the bearing can be tried thus: Loosen all main bearing caps and shim them up so they do not touch the shaft. Then measure down from a fixed point with a micrometer to the top of each journal through the oil hole in the top of the main bearing cap. Now put a piece of cardboard between each main bearing cap and the shaft and draw the shaft down solid with the nuts of the bearing caps. Again measure the distance from the fixed point above each journal down to each journal. This will show you if any bearings have not proper support and also how much the bearing shell is low.

In any case, after a diesel has run for about two years, it is best to re-bed the shaft. This not only checks alignment of the bearings and crankshaft, but also corrects any irregularities caused during operation.

For further maintenance data, see pages 179-181 of *Power*, April, 1935.



Emergency Repair on Air-Compressor Valve Stud

RECENTLY while overhauling the valves of a large compressor one valve-seat supporting stud pulled out of the cylinder casting when the nuts were tightened. Examination showed a flaw in the casting responsible for the break. A piece of the casting pulled away with the stud, but the break did not extend into the water jacket, Fig. 1.

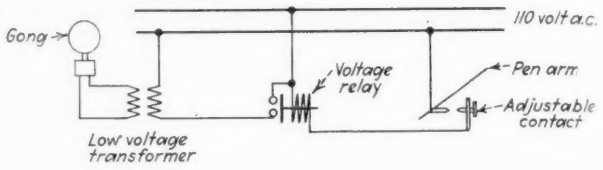
As the machine could not be down long enough to make a permanent repair, we decided to hold the valve seats in place with a jack against the cylinder head. This would transfer the load formerly carried by the valve seat supporting stud to the cylinder studs, but they had ample capacity. The supporting stud was stepped, being $\frac{7}{8}$ in. in diameter through the discharge valve seats and $\frac{3}{4}$ in. through the intake valve seat.

A piece of cold-rolled steel was turned to the dimensions of the stud, with the $\frac{7}{8}$-in. section cut off flush with the top of the discharge seat and the $\frac{3}{4}$-in. section extended to rest against the end of the cylinder-head valve chamber. Both sections were threaded, extending the thread on the $\frac{3}{4}$-in. section clear to the end. A footing was then made for the jack to distribute the pressure against the cylinder head, Fig. 2. By assembling the valve seats loosely on the jack and letting them rest against the footing, we were able to place the whole in position and secure each valve seat in its place.

Rockland, Me. J. M. POMEROY

Peak-Load Indicator Sounds Alarm

TO HOLD maximum demand of a small ground-wood pulp mill to a predetermined limit, a homemade peak-load indicator was assembled from instruments and parts that were available at the plant. A graphic polyphase wattmeter that was not in use was equipped with two contacts to close a circuit when the meter pen moved across the chart. These contacts were connected to a 110-volt alternating-current supply through a voltage relay, the contacts of which closed the alarm circuit through a bell-ringing transformer and an 8-in. gong.

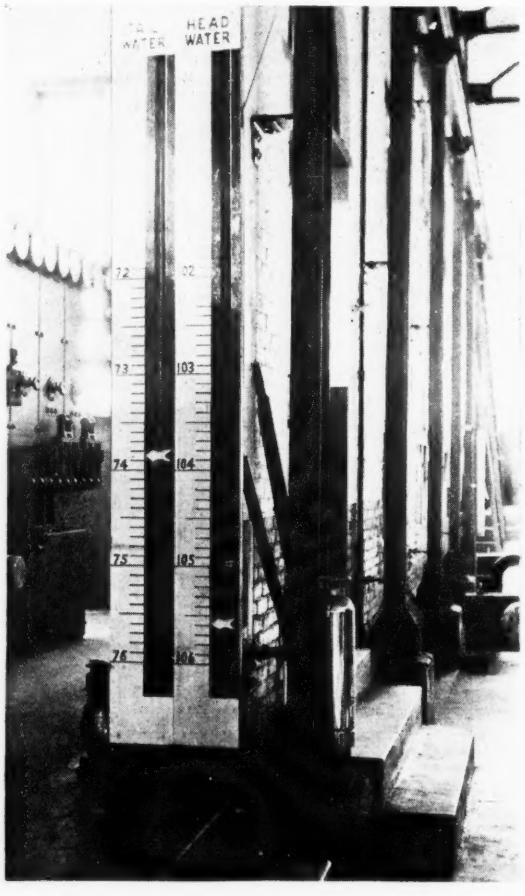


The load chiefly comprises pulp grinders, one line consisting of two 3-pocket grinders controlled by a load regulator and one line of 3-pockets only, non-regulated. The balance of the load included wood-handling equipment, pumps, screens, presses and wet machines all operated at fairly constant load. When the predetermined point in the load is reached, the gong, which is located at the 3-pocket line, gives an alarm and the operator immediately knocks off one or more pockets until the alarm is silent.

Nipigon, Ont. H. E. STAFFORD
Electrical Supt.
Nipigon Corporation

Gage Shows Head- and Tail-water Levels

BROWN CO., Berlin, N. H., has a hydro-electric station on the Androscoggin River at Gorham, N. H., where the chief operator, Mr. Hale, has made a water gage by which water level at the dam and tailrace may be read in the station. This gage consists of two painted boards set vertically side by side



as shown. Each is graduated in feet and tenths of a foot. The right-hand one is for head-water, the left-hand for tail-water level. Water level of the dam is taken as 100, but as there are flash boards, the readings go above that value. An arrow indicator on each board moves up and down with water level by means of a copper float at the gate house and in the tailrace. Indicators and their respective floats are connected by flexible wires passing over pulleys. Datum points at gate house and tailrace were determined by surveyors.

Suppose the head-water indicator shows 105.5 and the tail-water indicator 74. The difference between them is 31.5 ft., which is the head at the plant. It can be readily determined by reading the scale and subtracting.

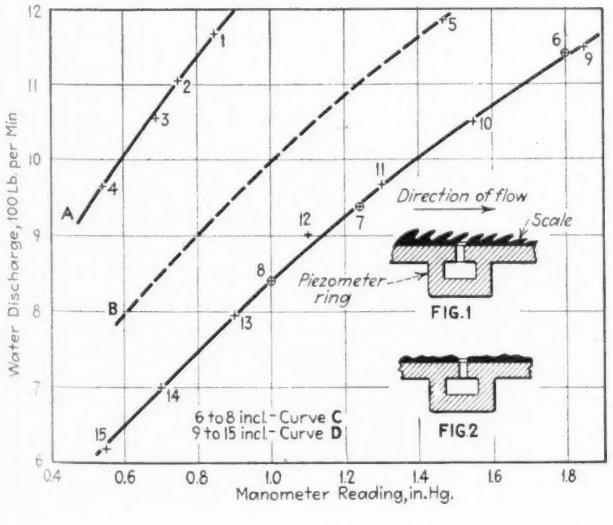
Before this simple instrument was available it was necessary to make hourly trips to the gate house and the tailrace to read the levels. In addition to the need of knowing what the head is at the plant it is also necessary to make reports every hour to Lewiston, Me., from where river flow is controlled.

Center Conway, N. H. FRANCIS A. WESTBROOK

Scale in a Venturi Tube May Cause False Readings

WHEN a venturi-meter tube installed between an open feed-water heater and a feed pump was removed for calibrating, the inside surface of its upstream section and entrance cone was found covered with scale. This scale was like miniature stalactites with their ends pointed in direction of flow, Fig. 1. It was decided to obtain a calibration curve before cleaning, to compare with a curve obtained after cleaning, to determine the effect of the stalactites. Curve *A* is from data obtained before the cone was cleaned. After obtaining data for curve *A*, the pump was shut down for a few minutes and then restarted, and its speed and valve adjusted to give approximately the same discharge as for point 1. It was found that the differential pressure had increased as indicated by point 5, which is far from point 1, probably because of the reduction in size of the stalactites. Cold water was used for calibration and likely dissolved some of the stalactite substances.

The equipment was shut down for two hours, then curve *C* was obtained including points 6 to 8. When the venturi-meter tube was removed from the line, the stalactites were reduced in size as in Fig. 2. The entrance cone was cleaned thoroughly, put in the line and another series of test runs made, which gave the data in curve *D*, points 9 to 15.



In the original test, the stalactites leaned over the piezometer rings openings, Fig. 1. Water flowing over these stalactites probably caused an aspirating effect to reduce pressure in the piezometer ring and a differential pressure lower than it should be for the amount of water flowing. The manometer mercury level did not remain stationary during the first test. This supports the idea of an aspirating effect. As the stalactites dissolved, the aspirating effect decreased and differential pressure increased. This is shown by curves *A*, *B*, and *C*. Curve *B* through point 5 is drawn to indicate the probable curve that would obtain had tests been continued at that time. Curves *C* and *D* are nearly identical because the surface of the remaining scale was similar to the rough casting of the entrance cone.

Comparing curves *A* and *D* indicates the error involved. Suppose the manometer reading is 0.6 in. Curve *A* for the venturi meter with stalactites indicates a discharge of 1,005 lb. per min. Curve *D* gives actual discharge 645 lb. per min. The error is 55.8 per cent. For 0.8 in. curve *A* indicates a discharge of 1,134 lb. per min. while the actual discharge, read from curve *D*, is 746 lb. per min. In this case the error is 52%. Boiler and furnace efficiency would be affected correspondingly.

Cambridge, Mass. W. H. PETERS

Condenser Scale

SCALE formation in condensers where circulating water is obtained from a river or stream and after passing through the condenser is wasted, is not likely to occur. However, it is possible, depending upon local conditions.

Condenser scale is usually due to the deposit of calcium and magnesium carbonate, although there are some instances in which scale deposits are hard and flintlike, resembling calcium sulphate. In reference to the latter type, I have in mind a steam-generating plant which used water out of a bay which was a part of the Gulf of Mexico. This condenser had a hard flintlike scale which dulled tube-cleaner cutters so badly that they could not be used for more than three to five tubes. The scale deposit in this case was approximately $\frac{3}{32}$ in. thick. Average temperature of bay water is 85 deg., and the rise through the condenser is from 16 to 18 deg. A complete analysis of this water is not known, however, the bicarbonate content was low, while total hardness was high—around 6,000 p.p.m. Chlorides, of course, were high also, as is the case in all ocean water. The low carbonate content of the water was due probably to the growth of oysters, muscles, barnacles, shells, and various other carbonate-consuming ocean life. Due to operating conditions, this condenser would go "atmospheric" about twice a month, at which time it is likely that the hard scale was deposited. Of course, this is an exception to the usual condenser scale formation.

Scale formation due to the deposit of calcium and magnesium carbonate may occur in a condenser regardless of whether it is supplied with fresh water or not. Of course it is understood that condensers which operate on spray ponds will have more trouble from scale formation than those supplied with fresh water, because of the mineral concentration which must occur due to the evaporation that must take place

in a spray pond in order that the pond water can be cooled.

Calcium and magnesium carbonate do not adhere readily to surfaces, and in order that scaling conditions be ideal, a cementing medium is necessary. Nature uses "slime" as the cementing effect in carbonate scale formation. This slime is the result of organic growth and can be eliminated by chlorination of the condenser water. This will greatly diminish the tendency toward scale formation. Fresh water from streams or rivers usually does not possess slime unless it is polluted by organic wastes from industrial plants. This probably accounts for the lower scale formation from river water. These waters also carry a small amount of sand in suspension, which helps to keep the tubes "sanded" clean. Suspended sand is absent in well waters and lakes. Some cementing effect is obtained from waters containing slimy mud as is found in stagnant water supplies.

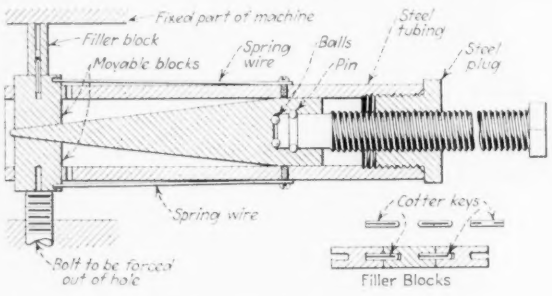
Another item in condenser scale formation is the velocity of the water through the condenser passes. The higher this velocity the less tendency there is toward scale formation due to the washing effect. Of course, if suspended sand is in the water, the scouring effect will be greater.

Some authoriites claim that aeration of the water by means of a spray nozzle will result in absorption of carbon dioxide from the atmosphere. I at one time worked on a spray pond that was throwing out enormous amounts of carbon dioxide. We thought that by building up the carbon dioxide content of the spray pond water that the scale could be prevented. This was tried by pumping large quantities of flue gas containing 10% carbon dioxide into the spray pond. However, after the water had been sprayed through the nozzles, not a trace of carbon dioxide could be found. Incidentally, the problem was solved by treating the pond water with acid.

Victoria, Texas B. F. HEGE

Bolt Starter for Use in Small Space

WHEN a machine is taken apart, sometimes after removing a nut a bolt will be difficult to start from its hole. If the bolt is so located that it cannot be driven out by a hammer, then it must be forced out. Several types of bolt starters have been developed, both hydraulic and mechanical types. The diagram shows one of the latter type that I made to replace a tool using grease as a pressure fluid.



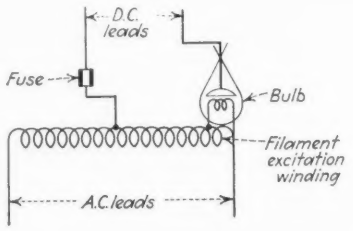
The body of this tool is a piece of $2\frac{1}{2}$-in. steel tubing threaded on one end for a plug through which the pressure screw operates. The other end of the tube body is bored through for two forcing blocks shaped on their inner ends to fit onto the driving wedge. The forcing blocks are held in place by two pieces of spring wire, one end of which fits into a hole in each block, the other end being attached to the steel tube by machine screws. Balls are used between the end of the driving screw and head to reduce friction between the two to a minimum.

As shown, to start a bolt the driving blocks are placed between the bolt end and a fixed part of the machine, excess space being made up with a filler block. Pressure is then applied to the bolt by forcing the wedge-shaped head between the movable blocks with the driving screw. If bolt has to be forced all the way out of the hole, other filler blocks are put in to take up the space as bolt moves out. These filler blocks are made in different lengths to suit conditions. When it is desirable to keep these blocks centered on one another and connect them together, this can be done by cotter keys as shown. Any one of the three designs may be used, whichever is most convenient to make.

St. Paul, Minn. ARTHUR MUNCH

Simple Changes in Rectifier Double Life of Tubes

HERE is a wiring diagram for one common type of battery chargers using a half-wave rectifier tube. Battery terminals are connected to the direct-current leads, the plate or right-hand lead being the negative terminal. When the rectifier tube is mounted as shown, the filament is suspended horizontally between two supports. Due to its high temperature it will eventually sag away from the plate. This will make it hard to start the tube rectifying, and it will finally fail to charge even though the filament is still intact. By changing the socket mounting so that the tube is placed on its side, the filament sags parallel to the plate, and the tube will not be hard to start.



With the filament winding connected as shown, most of the electrons leave from one end of the filament, and this end will finally burn out. Reversing the filament leads about every three to six months will considerably increase filament life. It is hardly practical to put in a reversing switch in the circuit because the low voltage of this winding makes loose or poor connections undesirable. It is a simple matter to change the connections to the socket with a screw driver occasionally. We have doubled the life of our rectifier tubes during the last three years by these two simple expedients.

Stillwater, Okla. ARNOLD BENSON

Suction Head on Pump to Handle Hot Water

WHEN water is pumped at 212 deg. F. from an open heater under atmospheric pressure, a positive suction head of 12 ft. must be maintained at the center line of the pump, for good operation. To insure that this head will be available at all times and allow for losses in the suction pipe, it is necessary that the center line of the pump be at least 15 ft. below the water level in the heater.

CURRENT COMMENT

Bonus Systems for Power-plant Employees

BONUS systems in boiler rooms are not as easily worked out as would appear, due to the many variables that have to be taken into consideration. I would like to add my thoughts to the discussion in the February number.

In various classes of manufacturing or production work, such as the making of machine parts or other articles where an employee turns out a large number or quantity that can be readily inspected and counted, weighed or measured, a bonus system may be worked out to good advantage to both employee and employer. But production of steam in a boiler room is a different problem.

In the small industrial plant where load is uniform and all equipment is maintained in uniform condition, a bonus system may work out to good advantage if properly supervised, but my experience with bonus systems in the larger generating stations indicates they will not work satisfactorily.

During the World War, I was employed by one of the large power companies in the Middle West. We found ourselves in the same condition as other public utilities, that is, we found it difficult with our fixed revenue to keep advancing wages in line with the rapid increases made by the various industrial concerns in our vicinity, especially those producing war material. To do as much as possible for our help under the conditions, we worked out a bonus system for firemen and as much of the other plant help as possible. This apparently worked well for a while, but our heavy load and limited generating equipment during that period soon made it necessary to operate boilers, turbines and condensers over longer periods without shut-down for cleaning, adjusting and various repairs so that the plant efficiency was difficult to maintain, much less improve. Therefore, the results were that the men soon became dissatisfied with the amount of bonus that they were receiving, even though we continued to try to make adjustments and allowances for the handicaps that appeared from day to day, such as bad draft, low-temperature feedwater, low vacuum, and the many other things that can affect boiler-room results especially when a plant is operating under trying conditions.

After about one year of it, we averaged up about what the bonus had amounted to under proper conditions and gave it to the men as an increase to their regular pay. This worked out much better for all concerned.

Under present conditions, with the better generating equipment and the surplus or standby equipment that almost all plants have, the bonus system might work satisfactorily. But if you fix up your boiler room in good shape and make the working conditions as good as possible under your particular conditions and give the firemen a salary well in line with others in your vicinity, I feel that you will get good results.

Some may feel that with present metering equipment it will be easy to calculate and make adjustments for a bonus system, but if the same effort and time is put in on good supervision of the plant it will pay a better dividend.

For the modern plant, it is possible to get good reliable men as firemen who, if given proper encouragement, will be found just as trustworthy and willing to help make savings in plant operation as the man at the cash drawer, and just as worthy of their hire.

Corpus Christi, Texas NELSON A. MINER

Efficiency of Auxiliaries Is Important

ON PAGE 19 of the January number the editor exposed a common fallacy. I agree with him that the efficiency of steam-driven auxiliaries *is* important, even where their entire exhaust is absorbed in heating feed water. The reasons are generally understood, but I feel that there must be some readers of *Power* who have not studied this matter carefully and who would therefore be interested in more details. Certainly, hundreds of thousands of dollars are being wasted annually by engineers who fail to recognize that the efficiency of steam-driven auxiliaries is always important.

Consider first the steam-driven pump. Part of the energy in the steam supply is converted into work in pumping water; the rest returns to the boiler in the form of feedwater heat. Offhand, this looks like a good showing for the feed pump, but if it is, an injector would do just as well, for it, too, delivers practically all of the energy in the steam in the combined service of pumping and heating feedwater. Then why not go a step further and heat feedwater with live steam? Here, again, practically all of the heat gets into the water, and there appears to be practically no waste.

Yet few operators would use an injector for regular service in pumping and heating feedwater, and almost none would use live-steam heating if any other means were available.

The real point is that the use of inefficient steam-operated feed-pumping devices means wasted opportunity—the opportunity to generate useful power as a byproduct of this heat.

Now the live steam feedwater heating generates no useful work at all. An injector generates a little; an inefficient steam-driven feed pump a lot more. Each is better, therefore, than the one before. The exhaust from an efficient steam-driven pump may not be enough to heat the feedwater. The remainder may then be furnished from one other source, which can then produce work at very low cost, to the extent that its exhaust is absorbed in the feedwater.

If electrical energy is produced in the plant the prime mover which drives the generator is probably the most efficient steam unit in service, because, for one thing, it is the largest. The cheapest way to heat feedwater is to draw steam for feedwater heat from one of the middle stages of the turbine, using a motor to drive the feed pump. In this manner more power will be developed by this additional steam in passing through part of the turbine than would be required by a steam cylinder driving the feed pump directly and the remainder of energy so developed will represent a saving.

For example, if the feed pump requires 100 lb. of steam per hp.-hr. work done on the water, and the turbine 30 lb. (for steam later bled for feedwater heating), it is evident that about three times as much of this extremely low-cost energy can be produced if the bled steam is used.

Gadsden, Ala. H. T. WATTS
Gulf States Steel Co.

QUESTIONS for Our Readers

Protecting Air Compressors Against Explosions

Question 1

IN OUR *plant we have two 1,000-c.f.m. air compressors. I believe serious explosions have occurred in compressed-air receivers and other parts of the system. Our units have always operated satisfactorily, but as a safety precaution I would like to have the opinion of* POWER *readers on what causes compressed-air explosions and how to best guard against them so that I may carefully check up on operating conditions.* —C.A.A.

Shoulders on Wristpins

Question 2

I HAVE *noticed that wristpins of our steam engines are eventually worn flat on the two portions of their circumference that take thrust. This creates shoulders at top and bottom and interferes with operation. I have been told this can be prevented by machining flats on the non-thrust portions of the journal. Before doing this, I would like to know if it is practical. If it is, where should the flats be located, and how much area should they cover? Or is it better to turn the pin, or to machine it undersize and fit new bearing shells?* —R.K.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Wet-Bulb Thermometer

WHAT *does a wet-bulb thermometer measure?* —C.R.J.

Actually a wet-bulb thermometer measures the temperature of the wet cotton or silk wick that surrounds the bulb of the thermometer. This temperature is depressed below the temperature of the surrounding air by the evaporation of some of the water in the wicking. The rate of evaporation, hence the degrees of depression of the wet-bulb thermometer, depends upon the humidity of the surrounding air. Its reading, together with the dry-bulb temperature, provide a means for calculating humidity.

Wet-bulb temperature alone permits determining the heat content of the air, which is constant for any wet-bulb temperature. In any change of humidity or dry-bulb temperature, wet-bulb temperature will remain the same if the total heat content of the air-vapor mixture does not change.

Condensate Under Pressure

WHEN *steam at 100 lb. gage is supplied through a reducing valve at 5 lb. gage to drying coils with the condensate discharged against atmospheric pressure and returned to the boiler at 180 deg., what percentage of saving would be effected by returning the condensate under 5 lb. pressure?*—W.L.H.

If the coils discharge direct to the atmosphere without being trapped, no comparison of economy can be made because of the unknown quantity of steam lost. If the coils are trapped and only condensate is returned to the boiler at 180 deg. (32 deg. below condensation temperature), it contains 180 — 32 = 148 B.t.u. per pound. If 5 lb. pressure is maintained in the return lines, the condensate temperature will approach the temperature corresponding to saturated steam at that pressure or 228 deg., but there is necessarily some drop in temperature between the coils and the boiler. Assuming the same temperature drop (32 deg.), the condensate in this case would enter the boiler at 196 deg., with a heat content of 164 B.t.u. per lb. Thus 164 — 148 = 16 B.t.u. would be saved.

To each pound of steam supplied to the coils the boiler originally added 1189.6 — (180 — 32) = 1041.6 B.t.u. The saving then is 16 × 100 ÷ 1041.6 = 1.5%. There is an additional, almost negligible saving, in boiler-feed pumping power due to the higher pressure of the condensate return.

BOILER VENT OPEN OR CLOSED WHEN FILLING?

ANSWERS to March Question 1

The Question

A SHORT *time ago we hired a new fireman, and to test his experience I one day instructed him to fire up a boiler that had been down for repair, but watched him closely. He examined the boiler to see that all manhole covers were in place and all valves closed except those to the water column and instruments, and then started filling the boiler. Presently I noticed pressure showing on the gage and realized that he had not opened the vent valve, thus trapping air in the boiler. I was interested to see what he would do, so said nothing. He continued filling the boiler until the pressure gage showed about 60 lb., and then inspected all the manhole covers to see if there were any leaks, blew out the water columns and then opened the vent to let out the remaining air. It had always been our practice to open the vent before filling the boiler, and yet this fellow's method had many good points. I am wondering whether* POWER *readers know of any bad effect from filling a boiler with the vent closed and why so many operators keep the vent open?* —P.D.O.

No Danger in Keeping Vent Closed

IT HAS been the usual procedure to vent a boiler while filling it, but half the engineers can't tell you why. There are a lot of theories, customs or whatever you want to call them, still being adhered to, for no other reason than that it has always been done. Not many of us have stopped to think why, or if there was any good reason for doing it that particular way.

How many times has a boiler been fired up, only to find a manhole gasket leaking? The walls and settings being all nice and hot, it is then necessary to wait for it to cool down before making repairs.

There is really no danger involved in leaving the vent closed until an air pressure of 50 or 60 lb. is built up. This gives an opportunity to discover any leaks, also a good chance to blow down the water column connections and make sure of correct water level before the fire is even started.

Detroit, Mich. WM. R. CUTHBERTSON

Don't Replace Hydrostatic With Air Test

MOST boiler operators keep the vent valves open when filling a dead boiler to allow displaced air to escape. This procedure permits quicker filling than if the vent is closed for any part of the filling time and decreases the pump power required, as the pump is working against atmospheric pressure within the boiler. Vent valves must be open (a) to drain water from a boiler, otherwise the water becomes air bound, and (b) when a cold boiler is fired up to expel the air above the water. In the latter case the vents are left open until a few pounds pressure shows on the boiler gage and the steam is blowing out the vents, then the valves are closed.

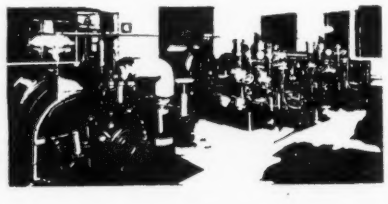
To close the vent valves until the pump has developed 60 lb. pressure on a boiler is a good method to use in ascertaining if hand and manhole plates are tight as well as some other joints around the boiler, especially small piping, if remade while the boiler was out of service. It should not, however, be used in lieu of a hydrostatic test if a tube has been replaced. In general, if a joint was tight under operating pressure before the boiler was taken out of service, it will be tight when returned to service.

Disadvantages in building up air pressure with closed vent valves are:

1. Subjecting the boiler parts to an unnecessary pressure strain.

2. Further straining them by suddenly opening vents and releasing the pressure.

3. Possibility of water absorbing some of the oxygen in the air under pressure and



eventually causing more corrosion of pressure parts.

4. Possibility that inadvertently vent valves will be not opened before pressure in the boiler reaches and exceeds the steam line pressure in which case water is passed out of the non-return valve into the piping system, with water hammer and probable line failure.

Pottsville, Pa. W. S. JOHNSTON
Mechanical Engineer.

Fill Boiler With Vent Closed

THE practice of filling the boiler with the vent closed is not only perfectly safe but has more than one advantage over the method of filling with the vent open. I know that the universal practice is to fill the boiler with the vent open, but I believe that this is one case where majority is wrong. It can be explained on the basis that man is by nature traditional and prefers to follow the beaten path rather than to pioneer a new route. I suppose the practice originated way back when boilers were filled from a low-pressure source. Under those conditions the vent must be open, and that practice is still aped.

In practically all plants where I have held subordinate positions I was given the customary instruction to open the vent. This instruction I followed blindly for many years, until one day I asked myself "why?" Since 1928 I not only do not open the vent in filling the boiler, but actually keep on pumping to 25% above the working pressure. I see no disadvantage in the practice, and there are a number of advantages.

In some plants the filling of an empty boiler is quite a problem, and it may take several hours. For instance, if the storage capacity of the surge tank is small, one cannot just open the feed valve and let the water go in the empty boiler, because it will take all of it, and the other boilers will go dry. Only a little water at a time must be fed. Imagine spending a couple of hours or more filling a boiler clear to the vent and then, when the vent is shut and some pressure built up, to find that some handhole, manhole, or tube leaks! All the water must be emptied and the filling process started all over. But if the vent is kept closed sufficient pressure to reveal the leaks is often built up when the boiler is half full.

I also believe that it is safer. It is the practice in many plants to apply a hydraulic test higher than the working pressure after any repair work has been done. In applying this hydraulic pressure, since there is no cushion, water hammer may develop that might be injurious under certain conditions. But with air trapped, there is no such possibility.

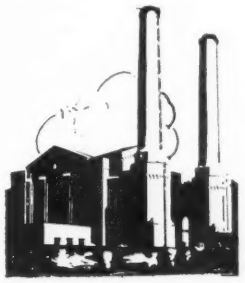
Chicago, Ill. N. T. PEF

Water Test More Dangerous

VENTING air while filling a boiler seems to be a universal habit passed along by instruction of leading codes and experts. A great many operators have evidently picked up this habit, considering the operation too trivial to give much thought to and content to do it as the other fellow did. A common-sense analysis of the factors involved when filling a boiler and leaving the air in it to be compressed by the incoming water will show facts to the engineer that will make for safer and more reliable operation of his plant.

There is no specific danger involved in using this compressed-air test. As in any boiler-room operation, the engineer in charge should be familiar with what he is doing and understand what is taking place in the boiler. The water test, which is an alternate for the compressed-air test, is much more dangerous and is not advisable for use by the ordinary steam man.

By not venting the air while filling a boiler, it is known that when the boiler is three-fourths filled with water, the gage will show about 60 lb. pressure, when four-fifths filled, about 75 lb. pressure will show. This



is an excellent time to examine the manhole gaskets for leaks. It is not such a good feeling to find a gasket cocked over and leaking after the boiler is steamed up, and the brick walls of the furnace are red hot. Nor is there much chance of pulling up the bolts to stop it then. The resulting loss of time and boiler availability necessitated by having to cool down and draw the water out of the bolier to fix a leaking gasket is easily visualized.

Another thing—if air pressure is used to test for leaks, it is a fine chance to blow out the water-column connections with this same compressed air and make sure of correct water level before even starting the fire.

Robinson, Ill. ROBERT BARNES

Oxygen in Air May Cause Corrosion

NO FEEDWATER conditions being given, I assume first that deaerated water at approximately 212 deg. F. is fed into the boiler with the vent closed.

In this condition most of the oxygen of the air will be absorbed by the feedwater as it enters the boiler.

This will cause rapid corrosion then and continue until driven off by heat applied to the boiler. Considerable time will be required in driving out the oxygen, as its solubility depends on the water vapor pressure and temperature.

If the vent is opened after the pressure has reached, say 60 lb. due to trapped gases, a small amount of air will be discharged but that dissolved by the water will remain in solution until released by furnace heat.

This entrained air will probably cause air binding in steam traps, heat exchangers and other equipment as it is gradually released from the boiler water, unless it is properly vented when warming up.

With the vent open under the same conditions as assumed at the beginning, the vapor pressure of the hot water will drive out of the boiler the greater part of the air.

The vapor pressure having driven out the air, there is very little chance of oxygen corrosion, as the air and boiler water are now separated.

In case cold un-deaerated water is used in filling the boiler with the vent closed, air is forced into solution as before, increasing as the pressure increases, but not in direct proportion.

With the vent open while filling and with only atmospheric pressure on the liquid, we only have to contend with the amount of oxygen combined with the water as it enters.

The vent should be left open while filling, especially if the water is hot. The vent should in all cases be open while warming up the boiler, to drive off all occluded gases.

Of course, if there is any real advantage in leaving the vent closed except for checking minor leaks, feedwater may be treated by addition of sodium sulphite to reduce oxygen corrosion to a negligible quantity.

Augusta, Ga. R. C. BAKER

Good Practice For Low-Pressure Boilers

I BELIEVE the method of testing a boiler by entrapping air when filling the boiler with water may be acceptable for low-pressure boilers when boilers have been in continuous use and the test is only to check up for tightness of hand or manhole gaskets and tube ends. By this method a little time may be saved. However, any leaks in safety valve, pipes connected to top of boiler, flanges or boiler seams are not noted as readily as when all air is removed.

On high-pressure boilers, boilers that have been patched or otherwise repaired, boilers out of service a long time or new boilers, a hydrostatic test should be made with all air removed, as any leaks at top of boiler or connections are more readily noted. As water is considered non-compressible, little trouble may result if a part of the boiler or a connection should break.

Stratford, Conn. M. C. NYE

BUILDING UP OIL CIRCUIT-BREAKER CONTACTS

ANSWERS to March Question 2

The Question

WE HAVE *recently started to build up our oil circuit-breaker contact wedges and fingers by oxyacetylene welding, employing copper wire for welding rods. We wish to know how well these welded contact surfaces can be expected to wear in comparison with new parts. It is understood that the composition of the metal deposited by welding is such that wear due to arcing will be so rapid as to make building up by this method unprofitable. How can these contact surfaces best be built up, and how can a metallic coating be*

applied that will prevent corrosion of these parts while in stock? —R.B.G.

Builds Up Contacts Successfully

WHEN oil circuit-breaker contact surfaces and fingers are rebuilt, it is necessary to fuse the new copper to the old section completely. While this is being done the contact will be annealed. Enough copper should be deposited by welding so that the section may be hammer-drawn to give the annealed part proper hardness. The method used in upsetting the crystalline grain structure for hardening depends on the shape of the contact. Most shapes are readily hammered.

After the part has been hardened, it may be machined to its original size. Before heating for rebuilding is begun, all pig tails and springs should be removed.

We built up the contact lugs and fingers on two 7,500-volt motor-starting oil circuit breakers about three years ago, by the method just described and have not had any trouble since. We remove the contacts once each year and smooth them up as was done with the original contacts before rebuilding.

If a metallic coating to prevent corrosion is desired, I would suggest tinning as the simplest and most economical method. Care should be taken to prevent annealing. We protect stock breaker parts without metallic coating from corrosion by spraying with breaker oil and wrapping in heavy oiled paper. If any part remains in stock for over a year, we re-oil and re-wrap. So far we have not had any trouble from corrosion.

Augusta, Ga. R. C. BAKER

Recommends New Parts

WE HAVE found no practical way of building up contact wedges and fingers of our oil circuit breakers. Our studies show that it is more economical to use new parts than recondition old contacts by welding. Labor and material cost to build up old contact surfaces by welding and dress them to nearly a perfect fit was found to be almost double that of new parts. Experience also showed that if the contact surfaces were not properly fitted, they heated and required replacement after one operation.

Our practice now is to inspect old circuit-breaker contacts after each operation. Usually the contacts need only minor dressing-up and are good for a considerable number of operations before requiring replacement. Of course, severity of pitting depends upon the load interrupted. Only in rare cases are the contacts pitted so badly that they require replacing after one operation.

I would suggest that in all cases where trouble is experienced with badly pitted contact surfaces that the matter be taken up with the manufacturer. The breaker may be operating on an interrupting duty greater than that for which it was designed. If such is the case, the breaker is a potential oil-fire hazard that should be corrected immediately.

North Bergen, N. J. K. B. HOFFMAN.

Use Phosphor-Copper Welding Rods

CIRCUIT-BREAKER contacts built up by welding with relatively pure copper wire cannot be expected to wear very well. Heating the rods to the point required to build up the contacts changes the properties of the copper considerably. These changes are caused by rapid oxidation of the copper at the fusing temperatures and annealing when cooling which takes place. This oxidation and softening of copper lowers its wear resistance and burning due to arcing is much more damaging than with the original contacts.

Much better results can be had by using phosphor-copper filling rods, when building up the contact surfaces. The phosphorus content of the rods, when molten, rapidly diffuses and destroys the oxide. A slight slag is also formed, which rises to the surface and forms a corrosion-protective film when the copper cools.

Filler rods containing only sufficient phosphorus to obtain copper free from oxide should be used. A metal containing too much phosphorus lacks fluidity, melts at a temperature much lower than copper, often produces defective adhesion, and reduces the electrical conductivity.

St. Marys, O. J. L. YOUNG

Built-Up Contacts Not Satisfactory

FOR greater life and maximum service, oil-circuit-breaker contacts should be installed in sets and very carefully aligned. Building up these contacts by welding should be done in emergency only. Heating the contact hot enough for welding anneals the copper, while the built-up portion is relatively hard and corrodes easily. Heating also weakens the finger-spring tension. It is difficult to get a true surface on the welded contact. In operation, built-up contacts burn easily and wear unevenly, due possibly to the lack of uniformity of the metal. Everything considered, it is more economical to purchase contacts for replacement than to build them up.

Waynesboro, Va. J. M. MYERS

MORE POWER for PALMOLIVE

*By Gosta A. Anbro**

Power Engineer
Colgate-Palmolive-Peet Co.

A 40-year-old mistake kept a power plant on 27½ cycles until last year. But modernization is bringing 60 cycles and design for anthracite.

WHEN electric power was introduced at the Colgate plant in Jersey City about 1896 an error in arithmetic in figuring the pulley diameter of a 25-cycle, belt-driven generator imposed a 27½-cycle, 2-phase, 220-volt, 4-wire distribution system on the plant, which is still standard for about two-thirds of plant power consumption. Production foremen were probably enthusiastic over the output of their machines, and no difficulties were experienced on account of the higher speed. Under these circumstances, to suggest a change which would decrease production capacity would be nothing short of sacrilegious. Thus, a power system of 27½ cycles grew up to 1928.

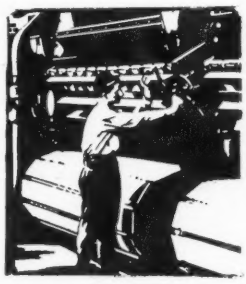
At that time a new process for soap powder called for power in excess of plant generating capacity. To get the process in operation without delay, central station power was purchased. In this connection we considered converting the purchased energy to parallel our own system, but with a direct-connected motor-generator set the least number of poles that would change frequency exactly was 48 on the 60-cycle and 22 on the 27½-cycle, at 150 r.p.m. This would be a bulky and expensive machine. Some company executives did not favor investing more money in 27½-cycle equipment, and as the advantages of adhering to a common nationwide standard were recognized by all, it was decided to introduce a second power system of 60-cycle, 3-phase, 440-volt, distributed over three wires. New distribution lines were run so that the majority of future motor installations could be 60-cycle, 2-phase. Since 1928 this system has grown to over 1,000 hp. installed motor capacity and 135 kw. installed lighting.

Naturally, the question of generating power at our own plant came up for consideration, as soap manufacturing is inherently well suited for generating its own power as a byproduct from steam requirements. The ratio of steam consumption to power consumption is between 50 and 250 lb. of steam per kw.-hr., depending on produc-

*Abstracted from a paper before the Metropolitan Section, A.S.M.E., Mar. 27.

tion methods, kinds of products, and climatic conditions. The average is about 150 lb.

Our old corliss engines take steam at 145 lb. and exhaust to 5 lb. gage. Originally all exhaust steam was used for process work and feedwater heating. But before 1928 changes in production methods had already decreased the demand for 5-lb. steam, so that a con-



siderable quantity was wasted in the summer. During the winter this excess was taken up for building heating.

Now the major portion of process steam is used at 90 lb. The feasibility of operating a steam turbine against this back pressure had been thoroughly established at other plants, but the highest admission pressure we could obtain from our old boilers was 145 lb., and this pressure range was too small to give a worthwhile quantity of power from process steam. High-pressure boilers were needed. Study showed that it would not be attractive to install high-pressure boilers solely for power generation. Even the incentive of higher efficiency for new boiler units was insufficient to make it a satisfactory investment, especially during the early depression years. We therefore decided to hold off installation of high-pressure boilers and extension of the power plant until the old boilers had to be replaced.

When is "Old Age"?

Replacement of boilers due to old age is a controversial question, but in our case it was settled when the insurance company advised us to cut down pressure within a year. We received this notice last summer and started at once to work out plans for the installation of new boilers and a new power plant to take the load now carried by central station power. These plans were approved in September of last year, together with a plan for changing all 27½-cycle, 2-phase equipment to 60-cycle, 3-phase, within approximately five years.

The question of fuel for the new boilers was settled in favor of anthracite, as it is decidedly the most economical fuel in our location under present prices. It has also shown less price fluctuation than oil and bituminous coal. Once the choice of fuel was made, the problem of fuel-burning equipment practically settled itself, as the traveling grate or chain-grate stoker has a practical monopoly on burning anthracite in power plants. Its efficiency with No. 3 buckwheat comes close to efficiencies obtained in bituminous coal plants. With No. 4 buckwheat the efficiency has in some cases been deplorably low, but requirements for success have been fairly definitely established, the principal requirement being large grate surface to hold down the burning rate to 25 or 30 lb. per sq.ft. per hour.

About a year earlier we had decided on 425 lb. pressures for our new Jeffersonville, Ind., power plant, which pressure gives ample possibilities for byproduct power generation, and still is not so high as to present any serious problems in feedwater treatment. At Jersey City we stepped up the pressure to the maximum allowed for No. 8 gage, 3½-in. boiler tubes, which is 448 lb. This gives us some additional available power which is desirable in view of the fact that the main office of the organization is at this plant and adds considerably to the regular production load.

Steam temperature was set at 600 deg., so that steam exhaust at 90 lb. pressure will have 50 to 75 deg. superheat. We consider this advantageous, particularly because this steam, besides its principal use for process, is used in numerous small steam drives around the plant. For pressures over 400 lb., some form of heat-recovery equipment becomes an attractive investment, so we decided on economizers. Considerations preceding this decision were quite complicated, involving space and cost, juggling different types of boilers and duct arrangements, different ratios of heat absorbed in the recovery apparatus to the heat adsorbed in the boiler, and the effect of preheated air on stoker maintenance.

Space conditions had a lot to do with the design and arrangement of equipment. We had a vacant space in the boiler room where one new boiler could be installed before we tore out any of the old ones. Since the building, coal bunkers and chimneys are in good condition, we decided to install new boilers in the old boiler room, even though the arrangement of the building and bunkers imposed severe restrictions in two directions. We are installing a 4-drum bent-tube boiler with an economizer in back of it. The boiler will be cross-baffled, and gas flow will be up through the economizer. This permits more effective settling of fly ash.

Whether to employ natural or induced draft was hard to settle in our case. We have two brick stacks 275 ft. high and maintained in good condition. It seemed odd to use induced draft in connection with these stacks. A low-draft-loss boiler and economizer could be made as efficient as a high-draft-loss installation by increasing the heating surface. The cost of this additional heating surface would only slightly exceed the cost of induced-draft fans. It would be desirable to avoid the fans, from the viewpoint of maintenance, reliability, and power usage. Induced draft, on the other hand, could more easily be arranged to provide draft for overload conditions and fitted better into the available space. Overload possibilities with induced draft finally clinched the decision.

New Boilers

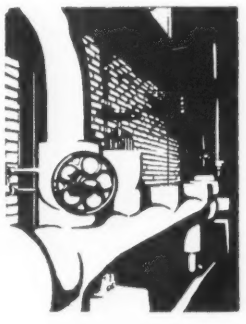
Capacity of the new boiler unit was chosen to equal about one-third of our total load, so that the plant may ultimately consist of four boilers, of which one would be spare. Two of these boilers are now being installed. Each contains 7,700 sq.ft. of heating surface, and the economizer about 3,000 sq.ft. They will generate 60,000 lb. of steam an hour, with a flue gas temperature of about 400 deg., and 80,000 lb. per hour with a flue gas temperature of 450 deg. Grate area is 287 sq.ft., which is considered sufficient to generate 60,000 lb. of steam per hour when using No. 4 anthracite, and 80,000 lb. per hour when using No. 3 buckwheat without undue carbon loss.

Water-cooled walls and arch we did not consider justified in view of the long life of plain refractories in anthracite-burning furnaces; also the amount of water cooling that can be introduced without courting ignition troubles is limited. The furnace will be of the rear arch design with front and side walls of tile supported from outside steel. This construction was chosen principally because any small section can be renewed without disturbing surrounding sections.

New electric generating equipment had to be housed in a new building erected on a vacant lot adjacent to the boiler room. Due to the high value of ground in our location, this turbine room is designed to support a later superstructure of six stories with a load of 250 lb. per sq.ft. For this reason, its interior appearance will differ from the general run of turbine rooms, and instead of a wide-open space there will be heavy columns between the generating units. One main generator of 1,000-kw. capacity is being installed now. A second main unit of from 1,000 to 1,300-kw. capacity will be installed later, during the five-year program. The first unit is to take steam at 420 lb. and will exhaust at 95 lb. The second unit will have the same admission pressure but will exhaust at 5 lb., and will probably have a bleeder connection at the 95-lb. stage. The reason for this uncertainty about the second unit are certain new developments in process work, the outcome of which is expected to be known within a few years.

Two Smaller Turbines

In addition to the 1,000-kw. unit, we are installing two smaller turbines to control supply and consumption of 5-lb. exhaust steam, to take care of week-end loads and to provide spare generating capacity. These smaller units will be geared, while the main unit is



direct-connected. One of the small units is a 250-kw. machine taking steam at 90 lb. and exhausting at 5 lb. The other is a 350-kw. machine taking steam at 4 lb. and exhausting to a condenser. Capacity of these units was chosen so that the exhaust from the back-pressure machine is equal to steam demand for the condensing unit at proportional loads. In other words, the two can be operated as one unit without affecting the availability of 5-lb. exhaust steam.

All auxiliaries are steam-driven, mainly for reliability and ease of control.

TEXTILE POWER-PLANT PRACTICE TENDS TO LARGER UNITS

Steam and power are vitally important to the modern textile mill. Here is a paper discussing trends, presented before the A.S.M.E. Textile Division, April 10, during the Southern Textile Exposition, Greenville, S. C.

By Robert M. Gates
Vice-President,
Combustion Engineering Company, Inc.

THE economy of the steam and power supply is an important factor in the textile industry. Events of the last two years have emphasized its importance as codes advanced both fuel prices and wages. Management should therefore give closer attention to its power problems as a means of reducing manufacturing costs. Where steam and power form a small part of finished product unit cost there has been a tendency to minimize their importance, notwithstanding that aggregate possible savings are large when interpreted into increased profits available for dividends.

A well-known manufacturer in another process industry recently installed a large modern high-pressure boiler to replace several old low-pressure small-capacity units. In the few months that this unit has operated, together with accompanying power-plant improvements, coal consumption has been reduced more than 200 tons per day. This is an exceptional case, but proportionate savings are possible in many other plants. The table gives typical installations in the South and in other states during the last six years. The information is not complete in all instances, nor are all installations included for the period considered. These plants, however, do represent a cross-section of steam plant practice in this industry, and certain deductions are possible from it.

Few textile plants in the South burn oil, several grades of West Virginia coal being available. Many plants having large boilers burn coal in pulverized form while stokers are used under the medium-size and small boilers. No particular type of boiler predominates and stokers of several types are found, although single-retort underfeed design seems to be favored for most medium-size plants.

A wide range of steam pressure is used, because steam conditions must be selected that will give the best heat balance for the particular plant, having due regard for initial investment and fixed charges. High-pressure equipment is now as reliable as low-pressure, therefore, the principal advantage of high steam pressure is to obtain more power from the steam. If this additional power is not needed higher steam pressure is unnecessary. High-pressure boilers, particularly high ratings, entail closer supervision of their feedwater than do low-pressure units.

Where the load warrants the trend is toward using a few large boilers to replace a multiplicity of small units. This means lower fixed charges per unit of output, higher operating efficiency and less labor. Ratings attainable with modern large boilers and their high availability factor reduce reserve capacity to a minimum.

Both back-pressure and bleeder turbines are common in the textile industry. For such operations as drying, dyeing, calendering cotton goods, steaming worsteds, etc., steam at about 15 lb. gage is suitable. This is obtained by bleeding from an extraction turbine where power demands are considerable, or where power requirements are smaller, the turbine may exhaust at this pressure. Heating is usually done at about 15 lb. gage, although, where steam distribution lines are quite long, it may be desirable to bleed at a higher pressure to keep down line size.

In worsted mills, print works and finishing plants, large quantities of hot water are required. This can be obtained by heating with exhaust or bled steam or by operating the turbine condensing at a vacuum that will heat the circulating water to a suitable temperature. In some plants two or three types of turbines are employed to obtain the desired heat balance and maximum operating flexibility. In a properly designed plant generating power in combination with process steam, if the steam and power demand are fairly well balanced, it is possible to produce a kilowatt-hour on 4,500 to 6,000 B.t.u., while the most efficient condensing plants (central stations) require about 12,000 B.t.u., and the average 15,000 to 18,000 B.t.u. per kilowatt-hour.

Plants in the table are representative of important mills. Many small mills, particularly in the South, are still hand-fired, due to availability of cheap labor. Labor and fixed charges are proportionately higher for small plants, hence it is advisable that such plants be designed along simple lines. Small stokers are now available at a cost and efficiency to remove all justification for handfiring boilers having over 1,000 sq.ft. of water-heating surface or even less in many instances. The savings through their use will usually return the initial investment in from one to three years.

Textile power-plant practice, particularly in the South, has been to show that this industry offers an exceptional opportunity for coordinating steam and power demands. Many mills are operating with obsolete equipment that may not be worn out, but much of it has outlived its economic usefulness. Many older plants, extended from time to time to meet production demands, have power-plant layouts unsuited to low-cost production. The problem now facing management in this industry is not one of expanding facilities but rather of reorienting them to obtain the best economic efficiency to help cope with increased taxes and rising fuel and labor costs and thereby increase profits.

Textile-Mill Boiler and Power-Generating Plants*

Type of Mill	State	Press. Lb. Ga.	Sup'ht. Deg. F.	Boilers No. and Sq.Ft.	[1]Firing	[2]Turbines No. and Kw.
Rayon...	Va.	435	260	1-8,650	P C	
Cotton...	S. C.	400	275	2-5,000	P C	1-5,000 B C 1-1,000 B C
Cotton...	S. C.	150		1-4,000	S	
Rayon...	N. C.	350	235	1-8,200	P C	1-3,000 B C
Cotton...	Ga.	225		1-4,860	S	
Cotton...	Tenn.	125		1-4,050	S	
Cotton...	S. C.	300	150	3-3,560	S	
Cotton...	N. C.	225		1-3,060	S	
Cotton...	N. C.	250	125	2-6,500	S	1-1,200 B P E 16 lb.
Rayon...	Tenn.	582	215	2-12,500	P C	
Cotton...	Ala.	195		1-3,600		
Cotton...	S. C.	400		3-4,000	S	
Cotton...	S. C.	200		1-4,000	S	
Rayon...	Tenn.	225	125	2-9,800	S	
Bleach...	Ga.	225	100	1-2,440	S	
Woolen...	Ga.	400		1-3,550	S	
Rayon...	Va.	300	160	3-6,500	P S	2-3,000 B B B 15 lb., E 2
Cotton...	Tenn.	160	150	2-3,750	S	
Rayon...	Tenn.	250	135	3-4,000 3-6,400	S S	1-1,500 B C 1-750 B P B 7 lb. E 22
Rayon...	N. C.	350	215	4-5,000	S	2-2,000 B C 2-650 B C
Knitting..	N. C.	300	170	2-5,000	S	2-750 B 30 lb., E 1
Cotton...	N. C.	250	140	3-4,000	S	1-1,000 C
Silk.....	Ga.	300	175	5-5,000	S	1-2,500 B 15 lb., E 1
Bags.....	Ala.	250		2-5,500	S	
Dyeing & Finish...	N. J.	450	150	2-6 500	P C	1-2,500 1-2,000 1-300 B at 100 lb.
Woolen...	N. J.	250	50	3-5,660	P C	1-1,250 B 1-750 C 1-300 C
Spinning..	Ill.	150	135	1-3,000	P C	
Spinning..	Conn.	225		3-6,500	P C	
Woolen...	N. J.	175		2-5,300	S	2-300 B P E at 45 lb.
Dyeing & Finish...	N. J.	360	30	2-8,250	P C	2-1,250 B P B 110 E 45
Rayon...	Pa.	450	190	3-10,800	P C	2-5,000 B C B150 lb.
Rayon...	Md.	450		4-10,000	S	
Knitting..	N. Y	300	120	2-4,550	S	1-1,250 B B at 5 lb.
Printing..	R. I.	200	100	6-3,000	O	1-750, B P 1-150, B P 1-37. 5, B E at 30 lb.

*For the years 1929 to 1934 inclusive.
[1]P C—Pulverized coal; S—Stokers; O—Oil.
[2]B C—Bleeder condensing; B P—Back pressure; B B—Bleeder back-pressure; E—Exhaust pressure; C—Condensing; B—Bleed pressure.

THE ENGINEER'S BOOKSHELF

Air Conditioning

AIR CONDITIONING AND ENGINEERING (1935). *Edited by the engineering staff, American Blower Corp., and Canadian Sirocco Co., Ltd. Published by American Blower Corp., Detroit, Mich. Two sections: Section I 359 pages, Section II 332 pages, 5½x11 in. Fabrikoid. Tables, charts and illustrations. Price $5.*

Authoritative reference book covering air conditioning, ventilation, blast heating and air engineering. Each of the 23 chapters is written by specialists and reflects the individual style and manner of presentation of its author.

The book includes fundamental principles, laws, and tables determined experimentally or mathematically; sample calculations in considerable detail; comprehensive information relating to dimensions and capacities; application data based on experience of the authors and contemporary engineers. In addition to the purely air conditioning and ventilation material, chapters are included which discuss air supply for ceramics and furnaces, mechanical draft, dust collection and mine ventilation.

The second section of the book contains extensive performance data and equipment dimensions on cooling towers, engines, coil heaters, fin heaters, decalorators, fans, hydraulic couplings, mechanical refrigeration, air conditioners, dust collectors, unit heaters, air washers, pumps, etc., made by American Blower Co.

Mechanics

MECHANICS OF MATERIALS (1935)—*By Profs. S. G. George and E. W. Rettger, Cornell University. Published by McGraw-Hill Book Co. Inc., 330 West 42nd St., New York, N. Y. 483 pages, 6 x 9 in. Cloth. Diagrams and tables. Price $3.75.*

Simple and complete, this text gives the engineer essentials on design of members according to modern methods. One chapter discusses the slope-deflection method, moment area method and theorem of moments. There are many examples and problems. Requires a knowledge of simple calculus.

A. C. Wave Forms

THEORY OF ALTERNATING-CURRENT WAVE FORMS (1935)—*By Philip Kemp, head of the school of engineering at The Polytechnic, London. Published by Instrument Publishing Co., 1117 Wolfendale St., Pittsburgh, Pa. Cloth. 218 pages, 5½x8½ in. 73 illustrations. Price $4.50.*

This volume is No. 1 in a series of monographs on electrical engineering being prepared under the editorship of H. P. Young, head of the electrical power and machinery section, The Polytechnic, London. The aim of these electrical monographs is to enable engineers and advanced students to obtain authoritative works on special and important subjects, which are either ignored or inadequately dealt with in standard textbooks. This volume is a highly theoretical treatment presented under the chapter headings: properties of complex waves, effects of iron, effects of other circuit conditions, harmonics in polyphase systems and harmonic analysis.

A. C. Circuit Protection

AUTOMATIC PROTECTION OF A-C CIRCUITS (1935)—*By G. W. Stubbings. Published by Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh, Pa. Cloth. 293 pages, 5½x8½ in. 209 illustrations. Price $5.*

Protection of electrical equipment ranks in importance with the equipment itself. Without adequate protection the machines or circuits may suddenly become non-existent except as a junk heap. In this book are treated the problems of protecting a.c. machines and circuits. A considerable amount of space is given to the theory of protective transformers and their interconnection and of protective relays. Modern protective circuits are also discussed.

The practical phase of the book falls into five divisions: protective transformers, interconnection of these transformers to form protective circuits, relays, modern methods of protecting electrical machinery and transmission networks, and testing relays and protective circuits. The book has been written essentially for electrical engineers, but the treatment is such that a large part of it may be easily understood by practical electricians, and it is therefore valuable to everyone interested in protective problems.

Brief Reviews

THE BRUSH PHASE OF MOTOR MAINTENANCE. *A 64-page booklet written by the engineering staff of the Ohio Carbon Co., 12508 Berea Rd., Cleveland, O., and distributed gratis to users of carbon and other types of brushes.*—This is a booklet for practical men and treats the brush problem under the headings: commutation in d.c. machine, d.c. vs. a.c., current collection on a.c. machines, types of brushes, physical and electrical characteristics of brushes, how to order brushes, installing carbon brushes, maintenance of brushes, other conditions affecting maintenance, and how Ohio brushes are made.

SURFACE WATER SUPPLY OF CANADA. *Water Resources Paper No. 69 contains results of researches by the Dominion Hydrometric Survey from Oct. 1, 1928 to Sept. 30, 1930, in New Brunswick, Nova Scotia and Prince Edward Island. 93 pages, 6¼x9¾ in. Paper. Free from Director, Dominion Water Power & Hydrometric Bureau, Ottawa, Canada*—Contains short explanation and 75 pages of stream-flow data on principal rivers and streams.

A.S.T.M. REPORTS.—*Published by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa.*—These include report of Sectional Committees on "Standardization of Dimensions and Materials of Wrought Iron and Wrought Steel Pipe and Tubing," "Preservative Coatings for Structural Materials," "Coal and Coke," "Methods for Testing Insulating Materials for Power Factor and Dielectric Constant at 1,000 Cycles."

A.S.T.M. STANDARDS ON COAL AND COKE. *Published by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. 108 pages, 6 x 9 in. Heavy paper binding.*—This publication gives all 18 specifications and test methods issued by the A.S.T.M. through the work of its committees. Methods of sampling, sieve analysis, shatter and agglutinating tests, etc., are covered. Classification requirements for coal by rank and by grade first issued this year are detailed, as well as specifications for foundry coke and gas and coking coals. One to nine copies, $1 each. Orders for ten or more, special price.

RULES AND REGULATIONS, DEP'T OF SMOKE REGULATION, HUDSON CITY, N. J. *Published by the Department at the Court House, Jersey City, N. J. 21 pages 3¾x6¾ in. Send $0.03 for postage*—Revised March, 1935. Governs details of fuel-burning equipment required for issuance of permits and certificates.

THE MECHANICAL WORLD ELECTRICAL YEAR BOOK (1935). *Published by Emmott & Co., Ltd., 31 King St., W., Manchester, England. Cloth. 311 pages, 4x6 in. Illustrated. Price $0.44.*—A practical electrician's handbook, this little volume appears annually in revised form. It covers a wide variety of electrical subjects, including generators, motors, transformers, rectifiers and converters, storage batteries, control equipment, wiring and others. A new section on rectifiers appears this year and other changes have been made to make the text conform to modern practice.

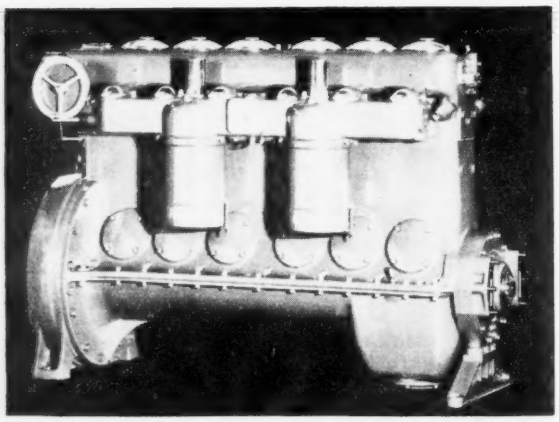
COOPERATIVE COLLEGE SYSTEM. *"30 Years of Educational Pioneering," by Herman Schneider. Published by University of Cincinnati, Cincinnati, Ohio. Free*—Explains cooperative system philosophy and results.

S.A.E. OFFICIAL STEEL SPECIFICATIONS. *Chemical compositions revised to Jan. 1935*—4-page folder of Republic Steel Corp., Advertising Dept., Massillon, Ohio.

THE INVESTIGATION OF ENGINEERING EDUCATION AND RELATED ACTIVITIES (1922-1933). *A summary of results by Chas. F. Scott for Society for the Promotion of Engineering Education, Pittsburgh, Pa.*—This is the 37-page summary of a 1,700-page, 2-vol. report giving exhaustive detail of an investigation.

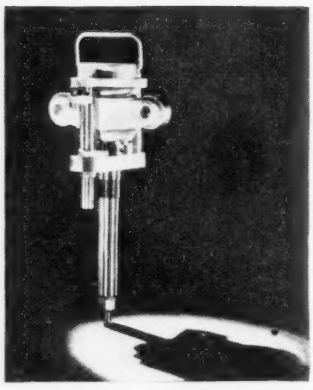
LEFAX—*Published by Lefax, Inc., Philadelphia, Pa.*—New publications include "Physical Chemical Properties of Methane," "Daily Capacity of Gas Wells," "Short Radius "Curve Data," "Coals of the United States —Analysis & Heat Values," "Standard Thicknesses, Weights and Tolerances of Nonferrous Sheet Metal."

WHAT'S NEW IN PLANT EQUIPMENT



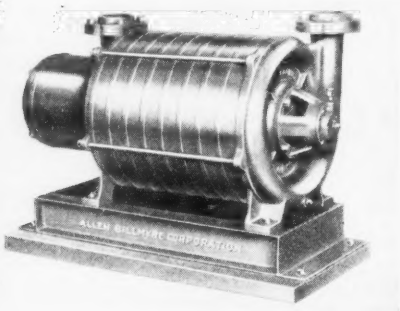
6-CYL. 5¾ X 6½-IN. DIESEL

MD SERIES is a 5¾ x 6½-in. 6-cyl. diesel with economical horsepower ranging from 100 to 160. Has combined fuel pump and nozzle, as shown in detail. This injector is in center of cylinder head surrounded by the four valves. It is actuated directly by two camshafts, one on each side, thus forming balanced drive. Injectors are spring-loaded and ride on cams, hence are always synchronized with engine. Oil delivered to injectors under 10-lb. pressure, in excess of requirements, surplus oil being returned to fuel tank, thus avoiding air-bound line. Actual injector pressure into combustion chamber ranges from 2,000 lb. idling to 4,500 lb. at maximum speed, this pressure occurring only at very tip of injector. Oil travel under pressure is less than 1 in. Eliminates all high-pressure fuel lines and pulsations in fuel line which result in intermittent injection. Unit can be removed and replaced in about 1½ min.



Unit started with gasoline burnt within its own combustion chamber; gives positive start by hand. Conventional 24-volt generator starting motor and battery system also available if desired. Crankshaft chrome molybdenum alloy steel counterweighted and balanced. All bearing surfaces hardened to 60 Rockwell. Steel shell high-lead bronze precision bearings on main connecting rods and camshaft bearings. Main crankshaft journals 4 in. in diameter, with crankpin bearings 3½ in. in diameter. Two overhead camshafts heat-treated steel, supported by seven main bearings of high-lead bronze. Pressure lubricated. One camshaft operates all inlet valves; other operates all exhaust, both operating fuel injectors mounted between. Camshaft driven from flywheel end by bevel gears and worm gears, with pressure-lubricated drive. Pistons of Lo-Ex aluminum alloy. Full-floating piston rings retained in pistons by snaprings. Cup-shaped stainless steel piston heads bolted onto piston, and insulated by stainless steel jacketed asbestos gaskets. Single alloy steel bolt with castellated nut and cotter pin holds piston head and gasket, thus allowing for expansion. Piston rings placed high up on piston to prevent trapping of soft carbon above top ring. Cylinder liners heat-treated alloy iron of heavy section. Cylinder heads cast as single unit of chrome-nickel molybdenum iron. This avoids warping and cracking. All valves and fuel injectors permanently mounted in cylinder head. Replaceable valve seats in cylinder head of forged alloy steel with special alloy seating surface. Water pump is 9½-in. dia. runner, mounted directly on crankshaft, cooling water being delivered at velocity of 3,000 f.p.m. at 1,200 r.p.m. All water passes through a heat exchanger, cooling lubricating oil. Lubricating oil pump also on crankshaft of gear. Lubrication at 60 lb. Variety of sizes, 1 to 6 cyl.

Murphy Diesel Co., Ltd., S. 53rd & W. Burnham Sts., Milwaukee, Wis.



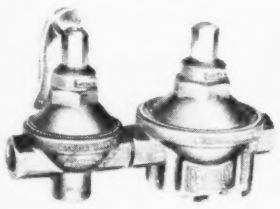
CENTRIFUGAL BLOWER

BLOWERS and exhausters are horizontal, single- or multi-stage, centrifugal type. Similar to steam turbines in design, with few moving parts. Air pressures of ¼ to 5 lb. per sq.in. or vacua from 1 to 8 in. Hg. Free-air volumes range from 50 to 10,000 c.f.m. Smooth, quiet operation, single balanced rotating element. No adjustment beyond occasional lubrication of outboard bearings. Casings heavy sectional cast-iron construction with interlocking notched joints. Inlet head has streamline diffuser vanes, outlet vortex or scroll design for uniform discharge. Model MOH medium-volume unit shown, with built-in motor. Also Model FB with motor or belt drive and Model SM high-volume unit with sheet steel case.

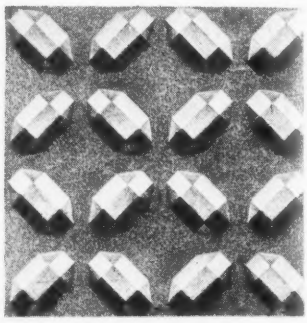
Allen Billmyre Corp., South Norwalk, Conn.

PRESSURE AND RELIEF CONTROL

TWO types, Model A, super control, and Model B, standard control. Model A has extra large capacity and is quick-filling type. Both high-grade steam bronze. Unit is used for keeping hot water systems filled with water and relieving excess pressure automatically. Combination of relief valve and reducing valve. Gaskets above and below laminated phosphor-bronze diaphragm. Sensitive and positive in action, resistant to heat and corrosion, and retains original flexibility. Special composition disks are sufficiently hard not to interfere with valve flow, yet soft enough to prevent cracking and provide perfect seating. Springs carefully calibrated and with higher fatigue resistance. Only spring exposed to water is that below seat in reducing valve. This is phosphor bronze. Large brass strainers. Relief valve has testing lever. Bulletin.



Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.



STEEL FLOOR PLATE

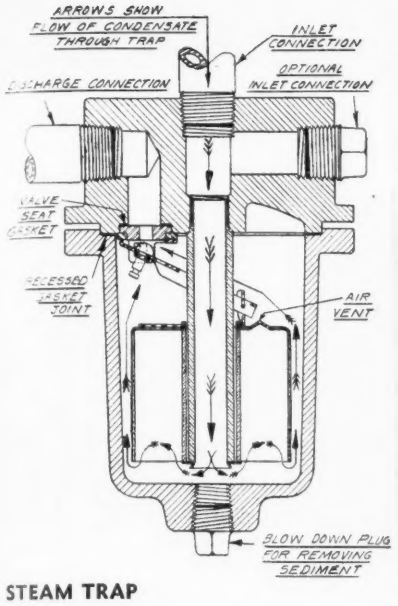
MULTIGRIP floor plate has surface developed, after long experimentation, to give high degree of skid resistance from every angle, with greater comfort under foot. No sharp proturbances. All lugs have flattened top surface. Cleaned readily and drains freely. No pockets in which water can accumulate. Symmetrical design minimizes cutting waste. Standard weights and sizes from $\frac{3}{16}$ to ½ in. thick, with maximum dimensions 84 by 480 in.

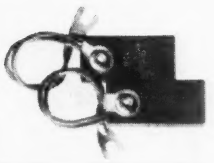
Illinois Steel Co., 208 South La Salle St., Chicago, Ill.

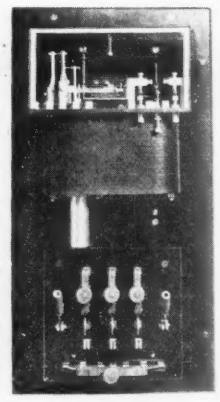
50-AMP. VERTICAL WELDER

W50-254 low-current arc welder has very stable high-speed arc, permitting it to weld quickly and efficiently down to 26-gage steels. No external reactors, resistors or separate stabilizers. Motor-generator unit with 3-hp. squirrel-cage motor operates on any a.c. power, including 110-volt, single-phase. Single current adjustment dial at top of housing. Vertical type, requiring under 2 ft. floor space.

Harnischfeger Corp., Milwaukee, Wis.







STEAM TRAP

SUPER-SILVERTOP inverted-bucket steam trap requires no pipe fittings for installation in steam lines. Two inlet connections at right angles, so trap may be used as an elbow or straight in line. Inspected or cleaned without disturbing pipe connections. Any or all parts may be renewed in 3 min. Bucket guided by tube, making knife-edge contact which avoids friction and preserves alignment. No impingement of condensate on bucket. Entering condensate is deflected to bottom of case and directed upward over a large area. Condensate discharges rapidly as it accumulates, regardless of temperature. No restricting areas. Air elimination automatic. Self-cleaning. All working parts heat-treated stainless steel. Valve and seat "Anderloy," a hard, tough, chrome alloy, to resist erosive action of steam and water. Cross-section shows valve open. Four sizes, for from ½ to 1¼-in. pipe, for maximum gage pressures of 150 to 250 lb. Minimum capacity of smallest unit at 1-lb. operating pressure is 200 lb. of water per hr., of largest size at 250-lb. operating pressure, 9,600 lb. of water per hr.

V. D. Anderson Co., 1935 West 96th St., Cleveland, Ohio.

VOLTAGE REGULATOR

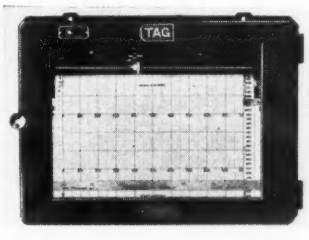
THIS vibrating-contact type unit is for maintenance of close voltage regulation in a.c. generator installations. Simplified construction. No dashpots or other damping or retarding devices. Delicate mechanisms with complicated circuits avoided. Main coil actuated by a.c. only. Main contacts platinum and iridium, and relay contacts tungsten or silver. Can be arranged for operation with one or more generators operating separately or in parallel. Regulator suitable for use with units of capacities from 1,000 to 5,000 kw.

Simplex Corp., Burlington, Iowa.

LIGHT-BEAM POTENTIOMETER PYROMETERS

HIGH-SPEED photoelectric action. Recording done by beam of light reflected by galvonometer upon a photocell, current from which is amplified to operate relay. Shutter intermittently raised in front of cell to detect deflection of light beam, and synchronized electric contact controls motion of contact carriage to and fro across chart and slide-wire. This balances instrument photoelectrically, bringing light beam to center of shutter, and mechanism records carriage position and turns multiple switch to new position. In controlling, beam of light from galvanometer is reflected to edge of photocell, only moving parts being galvanometer and relay. For indicating temperature, portion of light beam from galvanometer is intercepted by 45-deg. mirror and reflected upon a window over circular scale of the instrument. Accurate within 0.1 per cent. Models for on-and-off 2- and 3-position controls, in single or double range for thermocouples and resistance thermometers. Also indicating potentiometer with 15-in. circular scale.

C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.



HEAVY-DUTY D.C. BRUSHES

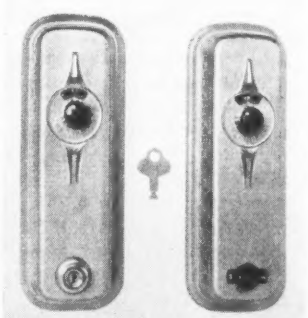
SA-SERIES National Pyramid brushes are of electro-graphitic type for use on d.c. generators, motors, and rotary converters. Five grades: SA-25, SA-30, SA-35, SA-40 and SA-45, each grade in progressive relationship to others, with respect to commutating and mechanical characteristics, thus making series cover an extremely wide range of applications. Identified by double engraved lines down center of one side, as shown.

Carbon Sales Division, National Carbon Co., Cleveland, Ohio.

CHEMICAL GOGGLE

SIMILAR to Duralite-50 hot worker's goggle described on page 160 of *Power* for March, 1935. Slight changes in design to adapt it for chemical use, such as molded eyecups to prevent liquid from reaching eyes. Slots in lens ring and radial slots in eye cups allow air circulation.

American Optical Co., Southbridge, Mass.



THERMOSTAT FOR AIR-CONDITIONING

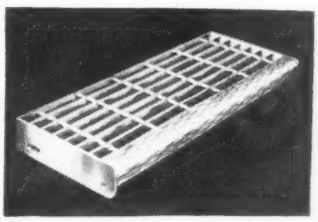
SENSITIVE to temperature changes as low as plus or minus ½ deg. F., and with design that eliminates possibility of chatter. Includes summer-winter manual switches built into case, and interwired so that all types of heating and cooling equipment can be operated from a single instrument during both seasons. Switch is either ordinary toggle type or for key operation (in public buildings). Changing position of summer-winter switch reverses action of electrical contact within instrument so that heating equipment is started on falling temperature in winter, while cooling equipment is started on rising temperature in summer. Case corrosion and scratch-proof. Bulletin A/X.

Julien P. Friez & Sons, Inc. (Division Bendix Aviation Corp.), Baltimore, Md.

SOLENOID SWITCH FOR HAZARDOUS DUST LOCATIONS

TYPE D dust-tight enclosures for Allen-Bradley 709 starters in polyphase ratings up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440-550 volts, also single-phase motors of self-starting type. Enclosure cast-iron, black enameled outside, white enameled inside. Cover and base surface machined. No gaskets. Top and bottom of base tapped for threading in conduit. Double-break silver alloy contacts. Soldered-type thermal overload relays reset without opening cabinet.

Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis.



STAIR TREAD

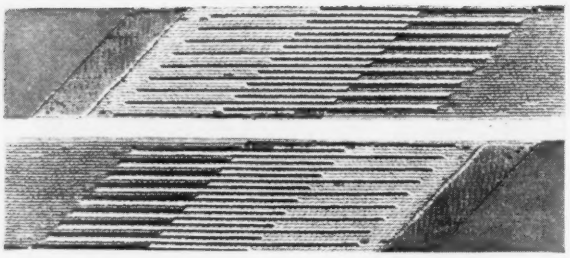
ELECTROFORGED stair tread is designed for strength against impact. Now manufactured with nosing of rolled diamond checkered plate. Made to withstand abuse. Intersections of bars electroforged into one piece under high pressure. Done without cutting, slotting or punching bars or removing any metal. Avoids loose parts or tendency to rattle. Twisted cross-bar gives maximum safety and grip for shoe soles.

Blaw-Knox Co., Pittsburgh, Pa.

LEAD-COVERED CABLES FOR 600 VOLTS

TWO new network cables, one leaded-type for ducts, other non-metallic for 600-volt service. Leaded-type has layer of Glyptal-treated cloth covering conductor, and two layers of asbestos over Glyptal. Both are treated with Pyranol, and the whole is inclosed in a lead sheath. This is flame-proof, and insulation will not give off explosive gases. Non-metallic cable for 600-volt service has Glyptal-compound sheath and rubber-compound insulation, which is highly moisture-resistant. This cable is suitable for use in oily or alkaline locations, where protection against abrasion is not necessary. Can be used in ducts or buried directly in ground.

General Electric Co., Schenectady, N. Y.



VULCANIZED BELT SPLICE

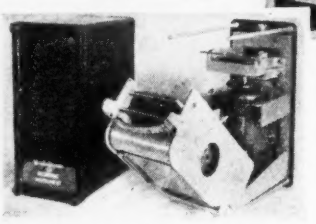
PATENTED vulcanized splice developed for Compass Cord transmission belt, permits it to be made endless in place. Belt ends joined together by dovetailing load-carrying core of cords at splice and by vulcanizing spliced portion of belt with special portable vulcanizer. This development permits users to purchase belting in roll-lot, non-endless lengths.

Goodyear Tire & Rubber Co., Akron, Ohio.

CHEMICAL PUMP

DEVELOPED for pumping exact quantities of water-treating chemicals into water supplied at intervals, dependent upon rate of water flow. Also adaptable to any type of liquid or semi-liquid chemicals and for close proportioning of coagulants. Rugged construction, smooth steady action without lost motion at all operating speeds, through center ball bearings and guide plunger. Stroke adjustment can be set from 0 to 3 in. Plunger adjustable for complete cylinder displacement, eliminating air pocketing. All adjustments are made with ordinary tools. Plungers special alloy and all working parts nickel semi-steel. Plungers and cylinder interchangeable from ½ to 3-in. diameter. The ½-in. cylinder operates safely up to 1,800 lb. pressure; 1 in. to 1,000 lb. Pressure lubrication, operable by water power, electric motor, ratchet or reciprocating motion, chain or belt drive. Height over-all 23½ in. Approximate weight, 125 lb. When used with Dearborn agitator-type chemical vat, makes a complete water-treating plant unit.

Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.



POSITION TRANSMITTER AND RECORDER

DUPLICATE position telemetering system for indicating and recording at a distance position of mechanisms, such as bridges, gates, valves or water level in hydro plants, engine governor positions or position of any important mechanism. Type "GH" is assembled in a rectangular case for switchboard panel mounting. Improved duplicate position type motor operates direct acting pen which records on a strip-type chart variations in position of remotely associated mechanisms operating a motor-type transmitted.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SAFETY SIGNAL

NUMBER of types of safety signals, automatic types open and close automatically. Look for lantern, socket for flag or flare, sets firmly on 2½-ft. triangular base. Special signs may be quickly snapped on stem. Folds to fit tool box and weighs only 7 lb. Height to top of stand 3 ft.; to top of flag 4½ ft. Also drive-type with 4½-lb. driving weight mounted on special steel rod. Unit simple, light and durable. 23 15-in. sq., baked yellow enamel sign plates with different standard legends; also blanks for special lettering. 15x18-in. red flags, Bulletin 322.

Martindale Electric Co., Box 2669, Lakewood Branch, Cleveland, Ohio.

HEAVY TILE CONDUIT

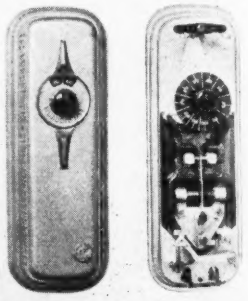
SUPER-STRENGTH tile conduit for underground steam lines may be used under highway or other heavy traffic, except railway. Extra heavy walls with special reinforcing at top, bottom and sides, producing balanced construction and maximum strength. A.S.T.M. 3-point tests show average crushing strength of approximately 3,000 lb. per ft. dia. per lin. ft., 16-in. size actually averaging 4,353 lb. 2-ft. lengths for all diameters, except 26-in., which is 2½ ft. in length. Special base drain, "Loc-Lip" side joint, external pipe supports, and interlocking construction. Insulation type optional, and no extensive special concrete construction required. Bulletin.

Ric-WiL Co., Cleveland, Ohio.

PLUG-TYPE VALVE

DESIGNED for service where there is excessive wire-drawing or destructive action on valve seat or disk, as in drip, drain, throttling, etc. Long seating surface between plug and seat can be readily reground or renewed if necessary when scored or cut. Due to angle of plug and seat ring sealing surfaces, stream flow is uniformly distributed when passing between these components, hence no wire-drawing. Seat ring screwed into diaphragm, providing easy renewal. Both seat and disk are of special nickel alloy of high Brinell hardness and can be reground indefinitely without removing valve from line. Spindle on cylinder affords back seat which permits packing stuffing box under pressure when valve is wide open.

Fairbanks Co., 393 Lafayette St., New York, N. Y.



HUMIDITY CONTROLS

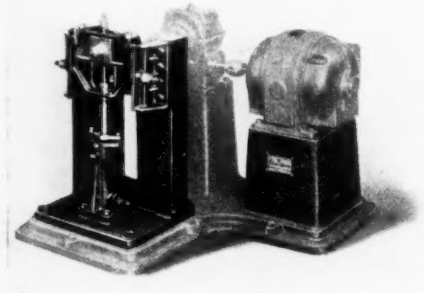
HUMIDISTATS with specially prepared multiple human-hair elements have been redesigned to give control to within plus or minus 1% relative humidity. Setting now by Bakelite knob and rotating dial, and range of 10 to 100% R.H. Case proof against corrosion, alkalies, brine, acids and scratches. Bulletin K.

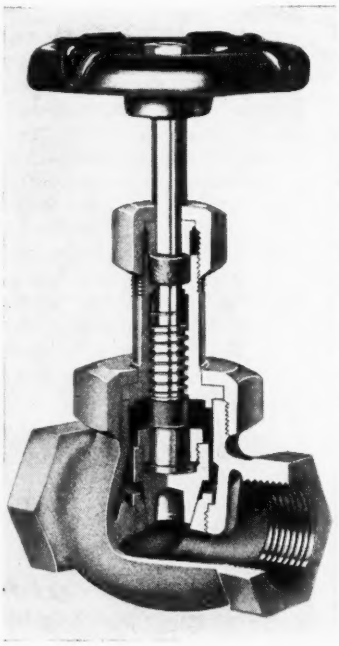
Julien P. Friez & Sons, Inc. (Division Bendix Aviation Corp.), Baltimore, Md.

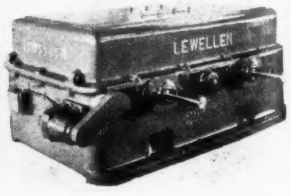
ELECTRIC REMOTE-CONTROLLED VARIABLE-SPEED TRANSMISSION

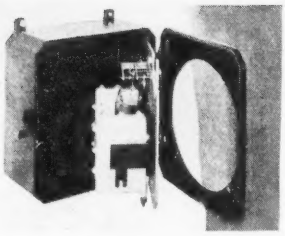
No. 175, Class D, completely inclosed Lewellen variable-speed transmission has electrical remote control. Unit illustrated is 84 in. long over-all, 54 in. wide, not including shaft extension, 38½ in. high, and weighs 5,620 lb. Capacity 40 hp. All interior parts, including ball-bearing thrust bearings, disks, and shaft bearings, are lubricated from one end from each shaft. Now manufactured in a series of standard sizes. Unit illustrated is largest completely inclosed variable-speed transmission thus far built.

Lewellen Mfg. Co., Columbus, Ind.









DRAFT PRESSURE AND DIFFERENTIAL RECORDER

SERIES "OT" and Series "OH" draft pressure and differential recorders for ranges between 0.1 in. water and 100 in. water total scale. Illustrated is 2-pen recorder, Type 2-OTL, with draft connection at bottom of lug-mounted case and back of flange case. Mechanism mounted on hinged chart plate for accessibility. Cases cast iron, dust-tight. 13 in. wide, 14 in. high, and 7 in. deep. Standard and special charts. Either single- or 2-pen type. 10-in. chart provides $3\frac{1}{8}$ in. of hand travel. Suspended pen arms allow pens to hang lightly against chart with constant and minimum friction. In 2-pen unit, pen arms swing clear of each other, longer pen recording about 5 min. ahead of shorter. Seth Thomas spring-driven or Telechron electric clock. Series OH are supersensitive recorders for low ranges of differential pressure. 10-in. charts provide more than 3 in. of pen travel for ranges of draft pressure or differential between 0 to 0.1 in. water and 0 to 0.4 in. Actuating mechanism round leather diaphragm. Case is cast iron or sheet steel, dust-tight, with lugs for wall mounting or flanged for flush mounting on instrument panels. $17\frac{1}{2}$ in. wide, $27\frac{1}{2}$ in. high and 9 in. deep. Bulletin 2017.

Hays Corp., P. O. Box 299, Michigan City, Ind.

CENTRIFUGAL FIRE PUMP

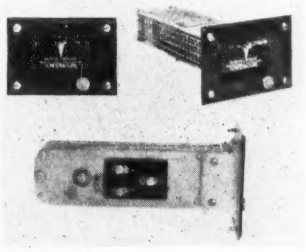
IMPROVED line of centrifugal fire pumps are Group LG, single-stage, volute type, direct-connected to electric motor, diesel, gas or gasoline engines, or steam turbines, and use smallest approved-size drivers in each case. Fully inspected and approved for service by National Board of Fire Underwriters and Factory Mutual Fire Insurance Co. Bulletin W-320-B1.

Worthington Pump & Machinery Corp., Harrison, N. J.

COLOR OIL TESTER

TAG-MACBETH A.S.T.M. Daylight Lamp for color determination gives illumination more closely approximating ideal daylight conditions for color tests than previous lamps. Suitable for use with TAG Saybolt Chromometer, A.S.T.M. Serial D156-34T; TAG Union Calorimeter, A.S.T.M. Serial D155-34T and D218-34T; also TAG Robinson Calorimeter. Union Calorimeters now equipped with lamp attached by adjustable bracket, and also flashed opal diffusion glass. Old units may be similarly equipped.

C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.



INSERTION-TYPE HUMIDITY AND TEMPERATURE CONTROLS

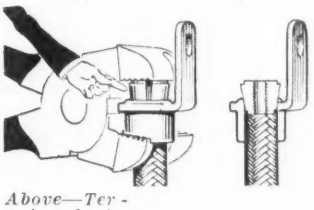
THESE humidity and temperature controls for insertion into ducts through walls, etc., or for insertion through cases of air-conditioning cabinets, incubators, test chambers, etc., are a development of wall-mounting type Humidistats and thermostats. Available either closely graduated in percent relative humidity from 11 to 100%, or in a variety of temperature ranges. Provide accurate and reliable control of humidity to within plus or minus 1% R.H., or temperatures to within plus or minus $\frac{1}{2}$ deg. F. Bulletin T/X.

Julien P. Friez & Sons, Inc. (Division Bendix Aviation Corp.), Baltimore, Md.

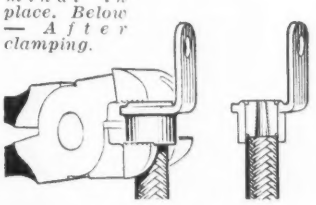
SOLENOID DUST-TIGHT SWITCH

TYPE E sheet-metal enclosures on Bulletin 709 switches of sizes 2 and 3, take care of polyphase motor requirements up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440-550 volts, as well as self-starting single-phase motors. Black-enameled outside, white-enameled interior. Thick felt gasket between base and cover. Hinged bolts and wing nuts. Conduit knockouts in all four sides and back.

Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.



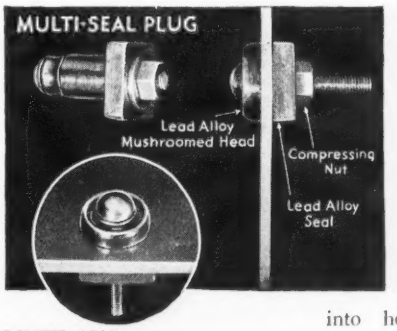
Above—Terminal in place. Below — After clamping.



CONDUCTOR TERMINAL

"WEDGE-ON" conductor terminal is installed by exerting heavy mechanical pressure on wire by forcing tapered wedge into barrel with specially constructed tool. Just enough insulation is cut off cable so that when it is introduced into lug, bare wire is within whole length of tapered wedge and insulation is supported by barrel. Speed and simplicity results in reduced cost and eliminates soldering. Wire sizes from No. 22 to No. 4. Tool given with orders for 200 "Wedge-ons."

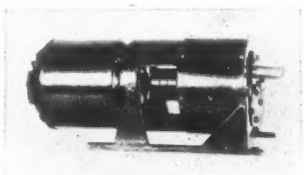
Thomas & Betts Co., Elizabeth, N. J.



RIVET AND ANCHOR BOLTS

"MULTI-SEAL" rivet and anchor bolt is used for sealing holes, cracks, or replacing rivets on steam, oil, hot water or air containers. Also for fastening patches over large holes. Will rivet sheet metal and can be applied from one side of job. Forms three seals and withstands 2,000 lb. pressure. Has fusing point of 900 deg. F. Large-head tempered bolt has ductile composition around it and ferrule just under bolt head. This is inserted in hole, then hex nut is drawn up while the square top of ductile material is held with a wrench. This upsets ductile material and fans out ferrule, making tight seal. Four sizes—$\frac{1}{4}$ in. (fills $\frac{1}{4}$-in. hole), $\frac{3}{8}$ in. (fills up to $\frac{5}{8}$-in. hole), $\frac{1}{2}$ in. (fills up to $\frac{3}{4}$-in. hole) and 1 in. (fills holes up to 2 in.).

Multi-Seal Mfg. Co., 7755 Sheridan Rd., Chicago, Ill.



HELICAL-GEAR REDUCTION UNIT

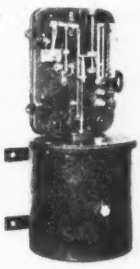
LECTRIGEAR a helical-gear reduction in sizes from $\frac{1}{8}$ to 2 hp. Standard footless motors used without changes in shaft or bearings. Furnished either with or without motors, and any of several standard-make motors can be used without change.

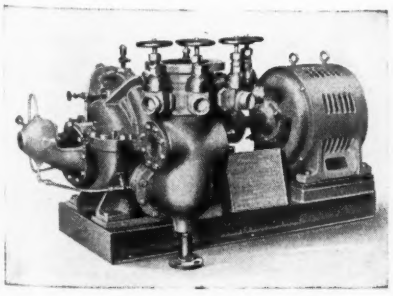
Ajax Flexible Coupling Co., Westfield, N. Y.

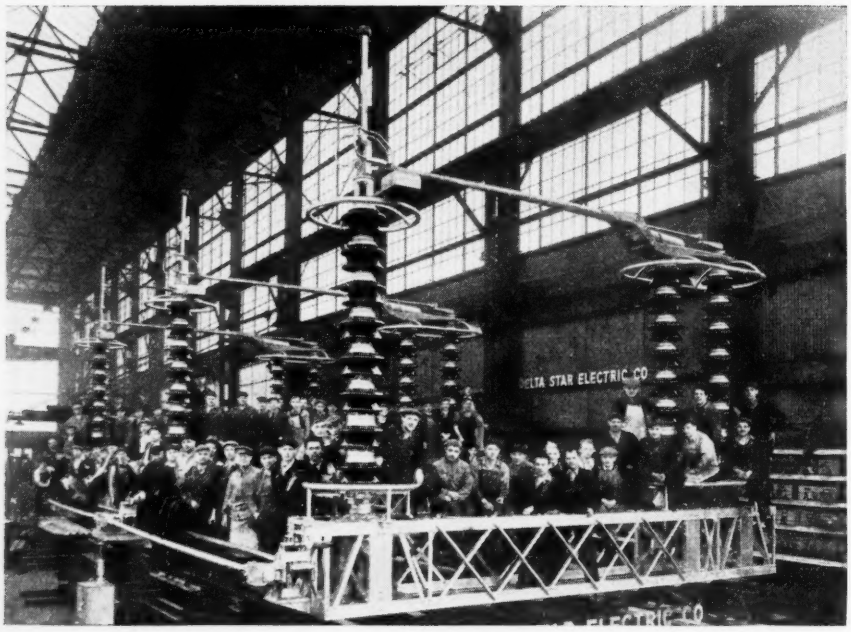
STATIC PRESSURE CONTROL

DESIGNED for applications requiring accurate control of low pressures up to 1 in. of water above or below atmosphere, for example in maintaining constant static head in air distribution systems for air-conditioning. Employs inverted bell with liquid seal as contact-actuating means. Push rod integral with inverted bell extends upward through top of cast bell and liquid housing into head of control, where, through simple lever mechanism, movement of bell, effected by pressure variation, is transmitted to control contact. Units may be used as positive or static pressure controllers, sub-atmospheric or draft controllers, or as differential controllers, application determining method of making pressure connections. Easily interchanged for these services. Bulletin 5-311.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.







ANOTHER "NEWEST AND BIGGEST"

This time a high-voltage disconnecting switch for Boulder Dam. Sixteen of these motor-operated 287,000-volt Delta-Star switches, weighing 15 tons apiece, will be used on the transmission line to Los Angeles. A man can operate one by hand or by pushbutton.

POWER LINES

National Power Survey Claims Power Shortage in U. S.

MARCH 31, the Federal Power Commission made public the first part of the Interim Report of the National Power Survey. This survey, authorized by President Roosevelt in August, 1933, directed the Commission to make a survey of water resources in the United States as they relate to the conservation, development, control and utilization of water power; the relation of water power to other industries and to interstate and foreign commerce; the transmission of electrical energy in the United States and its distribution to consumers, and on the basis of this survey to formulate a program of public works. The tentative but significant findings presented in the report are that:

"Use of electricity for domestic purposes as well as in certain branches of industry has grown at such a rate during the depression that, upon the resumption of normal industrial activities, the demand for power will be at least 4,000,000 kw. in excess of that which existed in 1929.

"Very little generating capacity has been constructed by the privately owned utilities since 1930. As a result, the capacity of existing plants is 2,325,000 kw. less than the demand that will exist for power upon a resumption of pre-depression industrial activity, assuming maintenance of normal reserve capacity.

"This shortage is being rapidly accentuated by the obsolescence of plants which would have been replaced under normal conditions. As of Jan. 1, 1935, 56% of the total installed steam-electric capacity of the United States was at least 10 yr. old, 11% was 20 yr. old or older, and about 1% at least 30 yr. old. Inefficient and obsolete plants with a capacity of at least 2,000,000 kw. should be scrapped and replaced within the near future.

"Analysis by districts of the relation between the capacity of existing plants and the demand that will be created with the resumption of normal industrial activity shows that critical shortages will exist in almost every section of the United States.

"In view of the time required to plan and construct large generating plants, whether hydro or steam, early construction of new plants with an aggregate capacity of between 3,000,000 and 4,000,000 kw. is imperative. This would involve capital expenditures of at least $300,000,000.

"The critical shortage of existing generating capacity most seriously affects the great industrial district of the East and Middle West."

Some of the findings in this report have been seriously criticized by Bernard F. Weadock, vice-president and managing director of the Edison Electric Institute. Mr. Weadock claims that actually the present excess generating capacity over and above requirements for normal reserve is 6,000,000 kw., or 20%, and the present trend in output does not justify plans for further construction. It is also claimed that peak loads of the different power systems in the United States do not coincide in time and, because of their diversity, the effective over-all peak is only about 16,000,000 kw., not 23,000,000 kw. as claimed in the Commission's report. Also there are 5,942,000 kw. of installed capacity in the United States more than the report shows, which is equivalent to nearly three times the plant capacity shortage claimed by the Commission. Old plant capacity mentioned in the report as being obsolete and should be replaced, Mr. Weadock contends, is perfectly capable of supplying power in emergency and of supplying peak loads.

Another authority who asked that his name be not quoted, holds that the correct answer is probably between the claims of the Commission and those of Mr. Weadock. There are many factors difficult to evaluate correctly that influence the answer to the problem. In 1929 public utility plants in the United States generated 97,000,000,000 kw.-hr. with an installed capacity of about 30,000,000 kw., making the load factor about 37%. On these systems there are now installed approximately 36,000,000 kw. of capacity. Assuming the 1929 load factor of 37%, this capacity can supply 116,000,000,000 kw.-hr. For a large part of this year, public-utility generation has been about 2% above 1929, and if this continues until next January the output will be about 98,000,000,000 kw.-hr. Therefore, on the basis of 1929 operation there is only excess capacity to generate about 16,000,000,000 kw.-hr. and practically no new capacity under construction, except that being built by the Federal Government. At the end of 1929, nearly, 6,000,000-kw. of utility plant capacity was under construction. Evidently if 1929 conditions can be used as a guide and there is a sizeable increase in industrial activity, present reserve utility-plant capacity will be absorbed quickly.

MAPI Surveys Potential Machinery Needs

A total of $18,574,632,000 in pent-up purchasing for six machinery groups is disclosed by final figures for the survey just completed by the Machinery and Allied Products Institute. Itemized figures are given in the accompanying table.

The MAPI survey was made directly through the members of its 58 member trade associations, each of which covers a separate industry and is representative of at least 80 to 90% of industry production. Details concerning needed machinery requirements were contributed through the use of a survey form covering type of machinery and cost. Detailed completion of the forms made it fully evident that industrial executives are well impressed with the economic need of replacement. It is also significant that while the survey form did not require company name, suggesting that identification be made instead by industry, companies almost without exception revealed their names.

These figures take no account of the dammed-up flood of business existing in industries apart from the machinery industries.

They do not include, for example, the broad equipment needs in other durable goods industries such as housing for 1,000,000 families, necessary rehabilitation of 16,000,000 homes, requirements for industrial housing estimated at $1,000,000,000 and other construction needs, all of which alone are variously estimated at $11,000,000,000 and more.

The total disclosed by these estimates approximates three-fourths of the official valuation of all Class I railroads in the United States. It is equivalent, in round numbers, to nearly the full amount collected in taxes by the government—federal, state, county, city, town, village and district—for two full years. It is half again as much as the accumulated deficits in the national treasury since the depression began. It is nearly four times as much as the tremendous total just voted by Congress for public works and relief during the coming fiscal year.

Potential Machinery Requirements—All Industry

Item	Requirements	Percent of Total
Agricultural implements	$731,840,500	3.94
Electrical machinery and apparatus	6,060,902,423	32.63
Engines, turbines, tractors and water wheels	**1,203,636,153**	**6.48**
Foundry and machine shop products	7,299,830,376	39.30
Machine tools	724,410,648	3.90
All other machinery	2,554,011,900	13.75
Total	$18,574,632,000	100.00%

65% of Metal-Working Equipment Over 10 Years Old

65% of this country's metal-working equipment is now over ten years old, *American Machinist* reports in its third 5-year inventory and obsolescence survey. This figure was reached after a study of 1,345,447 major items of machine tools, presses, forging machines and welding equipment, of which 879,522 were found over ten years old or "obsolete." Plant service and miscellaneous equipment and foundry equipment are reported separately with 52 and 58% respectively over ten years old. It is interesting to note here that POWER's survey of power equipment also showed 65% over 10 yr. old.

In 1925 the corresponding figure for metal-working equipment, according to *American Machinist's* Inventory for that period, was 44%, in 1930 it was 48%. Thus the 1935 figure shows a jump of 17 points, as compared with only four points for the earlier 5-year period. The survey reports:

"By the end of 1935 all equipment produced during 1925 will be over the ten-year mark. So, if we are to maintain our present percentage of modern equipment we must replace during 1935 an amount of machinery equivalent to that installed in 1925, neglecting the lag between placing the order and actual installation of a machine. Similarly output during the years 1936 to 1939 should approximate that during 1926 to 1929 respectively, if at the end of each year the industry is to keep its percentage of equipment over ten years old down to 65%.

"In terms of machines," *American Machinist* continues, "in order to maintain the present ratio of old to new equipment 336,745 major metal-working machines will be needed before 1940. The total indicated money expenditure over the same period would be $822,500,000, a figure which compares with that derived by a recent survey conducted by the Machinery and Allied Products Institute which gives a present pent-up demand for machine tools of $724,410,648.

GEO. RAHMANN & CO., 31 Spruce St., New York, N. Y., celebrated its 40th anniversary April 12 with a party and reception. The company makes leather belting and specialties.

Engineers Report on Means for Development

Developments in the cooperative program of engineering societies, educators, and representatives of state licensing boards looking toward improvement of the engineering profession and enhancement of the status of its members are recorded in the Second Annual Report of the Engineers' Council for Professional Development, published April 15. The report, copies of which may be obtained at the headquarters of the Council, Secretary, 29 West 39th St., New York, N. Y., is a pamphlet of 44 pages.

Harris & Ewing

TVA Chairman Arthur E. Morgan argues before the House Military Affairs Committee that part of TVA's costs should be written off as contributing to proper navigation

COMING MEETINGS

American Society for Testing Materials—38th annual meeting, Book-Cadillac Hotel, Detroit, Mich., June 24-28 (exhibit at same time). R. E. Hess, assistant secretary, A.S.T.M., 260 S. Broad St., Philadelphia, Pa.

American Institute of Electrical Engineers—Summer convention, Ithaca, N. Y., June 24-28. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

National Ass'n of Purchasing Agents—20th annual internat'l convention and Inform-a-Show, Waldorf-Astoria Hotel, New York, N. Y., May 20-23. Information from the Ass'n, 11 Park Place, New York, N. Y.

Nat'l Board of Boiler & Pressure Vessel Inspectors—10th ann'l meeting, Stevens Hotel, Chicago, Ill., May 14-17. C. D. Myers, sec.-treas., Brunson Bldg., Columbus, Ohio.

15th Exposition of Chemical Industries—Grand Central Palace, New York, N. Y., Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York, N. Y.

Great Lakes Power & Mech'l Exposition—June 24-28, on Steamer "Seeandbee," starting from Cleveland. Ernest H. Smith, managing director, 3910 Carnegie Ave., Cleveland, Ohio.

7th Midwest Power Show—Chicago, Ill., Oct. 14-18. G. E. Pfisterer, managing director, 1 North LaSalle St., Chicago, Ill.

Edison Electric Institute—3rd annual convention, Hotel Traymore, Atlantic City, N. J., June 3-6. Five sessions. Headquarters, 420 Lexington Ave., New York, N. Y.

American Society of Heating & Ventltg. Engrs.—Semi-annual meeting, Royal York Hotel, Toronto, Ont., June 17-19. A. V. Hutchinson, secretary, 51 Madison Ave., New York, N. Y.

Smoke Prevention Ass'n—29th annual convention, Statler Hotel, St. Louis, Mo., June 4-7. Frank A. Chambers, secretary, 139 N. Clark St., Chicago.

Heating, Piping & Air Conditioning Contractors Nat'l Ass'n—Annual convention May 20-22, Hotel Gibson, Cincinnati, Ohio.

Northwestern Retail Coal Dealers Ass'n—Radisson Hotel, Minneapolis, Minn., May 16-17.

American Society of Refrigerating Engineers—Spring convention, May 22-24, Statler Hotel, Detroit, Mich.

National District Heating Ass'n—Annual convention, June 11-14, Bellevue-Stratford Hotel, Philadelphia, Pa.

American Society of Mechanical Engineers—Semi-annual meeting, June 19-21, Cincinnati, Ohio. C. H. Davies, secretary, 29 West 39th St., New York, N. Y.

American Gas Ass'n—Annual convention, Oct. 14-18, Atlantic City, N. J.

American Welding Society—Fall meeting in conjunction with National Metals Exposition, Chicago, Ill., Sept. 30. W. Spraragen, secretary, 29 West 39th St., New York N. Y.

Loeffler Boilers Ordered by Three

A high-pressure Loeffler boiler has been ordered by the Italian Lloyd Triestino for the steamer "Conte Rosso." The 40,000-lb. per hr. boiler replaces a Scotch marine boiler of 16,000-lb. capacity. Two high-pressure turbines will be installed, coupled by gearing to each propeller. The two turbines will operate in series: one with steam at 1,900 lb., exhausting at 660 lb.; the other with steam at 660 lb. exhausting at 200 lb. It is anticipated that this will increase the speed of the ship by at least 1½ knots.

Repeat orders for Loeffler boilers were received from Moscow, U.S.S.R., and the German Dye Trust.

Announce Program of Oil and Gas Meeting

The 8th National Oil & Gas Power Meeting, A.S.M.E., to be held at Hotel Mayo, Tulsa, Okla., May 8 to 11 under auspices of the Society's Oil & Gas Power Division and Mid-continent Section, will include six technical sessions. There is being held at the same time a small exhibit of diesel engine parts and accessories. An inspection trip has been planned to the Hominy Pumping Station.

Papers include:

Experiences with High-Speed Diesel Engines in Pipeline Service, J. B. Harshman, Stanolind Pipe Line Co.

Characteristics of Diesel Fuel Oil, W. F. Joachim, Atlantic Refining Co.

Central Generating Plants Transmitting Power Electrically to Wells, George Bays, Stanolind Pipe Line Co.

Central Power Plants Transmitting Power Mechanically to Wells, Austin Allen, Phillips Petr. Co.

Central Power Plants Transmitting Power Pneumatically to Wells, Paul D. Cornelius, Sullivan Corp.

Diesel & Gas Individual Well-Pumping Units, Glenver McConnell, Shell Petroleum Corp.

Insurance of Diesel Engines, H. J. Vandereb, Hartford Steam Boiler Inspection & Insurance Co.

Experiences with Fuel-Injection Equipment in Oil-Field Service, Carl Behn, United American Bosch Co.

Compressed Air Transmission with Diesel Locomotives, Carl Bjornsson, Engr. Dept., Clark Bros.

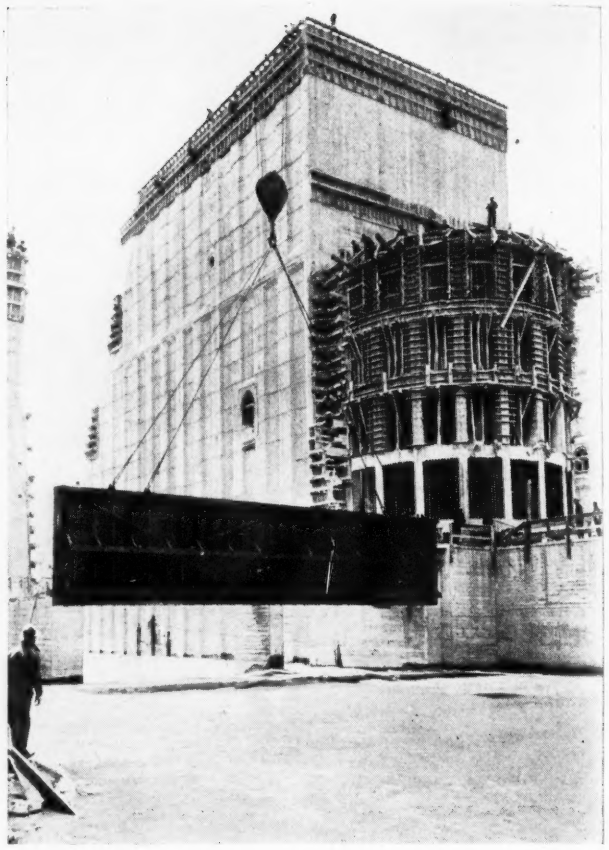
Informal discussion:

Experience of Explosions in Air Piping Due to Fuel Leaking into Air Systems, Air Compressor Explosions and Methods of Correction, Causes and Correction of Corrosion of Bearings and Crankshafts, Possibility of Control of Combustion Pressures in Solid-Injection Engines to Secure Smoother Operation and to Reduce Stresses on Working Parts.

NORRIS DAM IN THE MAKING

A 15-ton gate is lowered into place between two sections of Norris Dam, on the Clinch River, Tenn. A year ahead of schedule, this $34,000,000 TVA project will be completed in 1936

Wide World



Another Slant on E.C.P.D.

After publication of the news item "E.C.P.D. to Accredit Schools and Certify Engineers" (April *Power*, page 220), the following letter was received from Dr. D. B. Steinman, president, National Society of Professional Engineers.

"In your April issue under the heading 'E.C.P.D. to Accredit Schools and Certify Engineers' there appears the following sentence:

'To guard the professional title of engineer, the Council proposes to serve as a single body to examine who is qualified to practice as an engineer and use the professional title.'

"This quoted paragraph is a misleading statement. As a member of the Executive Committee of E.C.P.D., I can advise you that it was not the intention of the officers of E.C.P.D. to produce the impression which is thereby conveyed.

"Under the laws, no one has authority to determine who is qualified to practice as an engineer and use the professional title except the State Boards of Engineering Examiners. These State Boards through their National Council have established a joint agency known as the National Bureau of Engineering Registration, certification by which is generally accepted by the individual State Boards. One of the purposes of E.C.P.D. is to establish a minimum definition of an engineer and to certify men passing this minimum definition. But such certification does not qualify any man to practice as an engineer nor to use the professional title. Certification by E.C.P.D. will merely be a recommendation to the State Boards, which the State Boards may or may not accept. It will also be a recommendation to the National Engineering Societies as a qualification for admission to membership, which the National Engineering Societies may or may not accept. It will also be a recommendation to the engineering colleges as a basis for conferring the professional degree upon their former graduates, which recommendation the engineering colleges may or may not accept. None of these three interested agencies has as yet agreed to accept E.C.P.D. certification, even as prima facie evidence of qualification. Any other impression at this time is premature and is contrary to the established principles of statutory engineering registration. Inaccurate statements on this subject only tend to arouse misapprehension, and we do not want the different organization movements in the engineering profession to be placed in mutual antagonism."

[We are glad to publish the foregoing letter from Dr. Steinman to correct any false impression created by our report of the meeting. In fairness to "Power," it must be pointed out that the paragraph criticized is in close agreement with the following statement from the Committee's own news release of March 7:

"It is for the purpose of bringing some order out of the present chaotic condition that the Council proposes to serve as a central body to determine who is qualified to practice as an engineer and use the professional title."—*Editor*]

Used Machine Code Authority Approved

NRA has approved the Code Authority for the Used Machinery & Equipment Distributing Trade. Members approved include M. D. Galbreath of Marr-Galbreath Machinery Co., *chairman*; L. E. Emerman of L. E. Emerman Co.; A. Goldman of Riverside Machinery Depot; J. E. Middleton of L. F. Seyfert's Sons, Inc.; C. A. Simmons of Simmons Machine Tool Co.; J. E. Launder of Independent Elec. Machry. Co., and J. L. Lucas of J. L. Lucas & Son. Ralph S. Davis is executive secretary, with offices at 307 Empire Bldg., Pittsburgh, Pa.

N.Y. Professional Engineers To Meet May 18

The annual meeting of the New York State Society of Professional Engineers will be held in the grand ballroom, Hotel Roosevelt, New York, N. Y., May 18. Two sessions will be held. An exhibition of drawings, cuts and models will be open all day. A special luncheon meeting will also be held, addressed by several prominent speakers. Special hotel rates have been obtained for out-of-town visitors, available on application to H. G. Balcom, 10 E. 47th St., New York, N. Y.

BUSINESS NOTES

GEERLINGS & HENSCHEL, 647 West Virginia St., Milwaukee, Wis., have been appointed general agents in southern Wisconsin for Riley Stoker Corp., Worcester, Mass., on steam-generating and fuel-burning equipment.

NEW YORK BELTING & PACKING CO., Passaic, N. J., has made the following changes: Harry H. Raber, with the company for 15 years, has been appointed assistant to the general manager. J. W. Webster has been transferred to the territory comprising Tenn., Fla., Ala. and Ga. Donald F. Potter will take over part of Mr. Webster's old territory in Del., Md., Va., N. C., and Southern Pa. John V. Lanahan will take Mich., Ind., Ill., Ia., southern Ohio and Wis., and eastern Mo. O. L. Wall will take the Pacific Coast states.

REPUBLIC STEEL CORP., Youngstown, Ohio, has moved its New York sales office and export department to the Chrysler Bldg. Gilmore Steel & Supply Co., 825 Folsum St., San Francisco, Calif., has been appointed distribution for Enduro stainless steel.

GLOBE MACHINERY & SUPPLY CO., Des Moines, Ia., will represent McClave-Brooks Co., Scranton, Pa., exclusively in Iowa.

DELAVAL SEPARATOR CO., 165 Broadway, New York, N. Y., has moved its Chicago office to 427 Randolph St.

PERSONALS

ARTHUR C. HAYS, 1415 Carondelet Bldg., New Orleans, La., has been appointed sales representative there for Edward Valve & Mfg. Co., Inc., East Chicago, Ind.

JOSEPH C. JONES has joined Sanderson & Porter, engineers, 52 William St., New York, N. Y. Mr. Jones was with Ford, Bacon & Davis, Inc., until March 1, and formerly with Thomas E. Murray, Inc., in both cases in connection with industrial and public utilities works. He will be similarly engaged with Sanderson & Porter.

R. M. THAXTON has become exclusive valve representative in 16 counties in southeastern New York state, for Homestead Valve Mfg., Co., Coraopolis, Pa.

PUBLIC SERVICE ELECTRIC & GAS CO., Newark, N. J., has made the following appointments in its electric generation department: William F. Rippe, now chief engineer of Kearny Generating Station, is to be planning and installation engineer effective May 15, succeeding Walker L. Cisler, now general superintendent of generation. Donald C. Luce, load schedule engineer, will succeed Mr. Rippe as chief engineer of Kearny Generating Station. Philip H. Hartung, who has been fuel engineer, will succeed Mr. Luce as load schedule engineer May 1. James A. Rose, formerly test engineer at Essex Generating Station, succeeded Mr. Hartung as fuel engineer April 1. Mr. Rippe joined Public Service as a cadet engineer in 1922. He was appointed chief engineer at Kearny on June 1, 1934. Mr. Luce joined Public Service as a cadet engineer in 1924. He was transferred to Kearny Generating Station as test engineer in November, 1928. Dec. 1, 1929, he was appointed load schedule engineer and transferred to the general office.

EDWARD L. MORELAND, 50, senior partner of Jackson & Moreland, Boston, has been appointed head of the electrical engineering department, Massachusetts Institute of Technology, to succeed Dr. Dugald C. Jackson on the latter's retirement in June of this year. He was educated at Johns Hopkins and at M.I.T., and has been with Jackson & Moreland since 1908. Dr. Jackson retired in 1930 from this organization.

BERNARD H. PORTER has joined the Technical Department of Acheson Colloids Corp., 444 Madison Ave., New York, N. Y. He will devote a major part of his time to electrical applications.

EDMUND K. MURRAY, for many years identified with power-plant construction for Stone & Webster Engrg. Corp., Dwight P. Robinson & Co., and United Engineers & Constructors, has been appointed superintendent of plant engineering for Edgar P. Lewis & Sons, Inc., Malden, Mass., confectionery manufacturer.

JAMES HOLT, formerly a designing engineer for American Printing Co., Fall River, Mass., and authority on heating and ventilating engineering, has been promoted to associate professor of mechanical engineering at Massachusetts Institute of Technology.

E. KAPKE has been appointed assistant sales manager of the Crane Division, Harnischfeger Corp., Milwaukee, Wis.

ALBERT C. LEHMAN, president of Blaw-Knox Co., Pittsburgh, Pa., has been elected to the newly created office of chairman of the board. He has been with the company since its inception 30 years ago. Irvin H. Lehman, vice-president, becomes president, and Frank Cordes senior vice-president.

RAY L. HOWES, for the past 22 years with the Diesel Sales Division, Fairbanks-Morse & Co., Chicago, has joined Worthington Pump & Machinery Corp., Harrison, N. J., as field manager of the newly created Eastern Oil Power Division at 2 Park Ave., New York, N. Y.

R. Y. MACINTYRE who has served as Link-Belt Co. representative in Memphis, Tenn., since 1932, has been transferred to the company's district sales office and warehouse in Dallas, Tex., where he will assist E. G. Wendell, the local manager.

K. B. MCEACHRON, research engineer of General Electric at Pittsfield, Mass., whose studies in artificial lightning up to 10,000,000 volts have brought him world-wide recognition, will receive the Edward Longstreth medal of the Franklin Institute, Philadelphia, May 15. The award is based on his contribution of Thyrite, a substance used in more than 35 different electric applications, principally for lightning arresters. In this connection it has saved millions of dollars annually in protecting electric company equipment against losses from lightning damage.

FREDERICK A. YOUNG, 42, president of Power Service Corp., Providence, R. I., has been appointed chief of the division of public utilities for Rhode Island, succeeding the late regulatory commission at the capitol. Mr. Young is widely known in the power engineering field. He was formerly instructor of the New York Edison Co.'s school of engineering and organized the first school for operators for New York & Queens Electric Light & Power Co. Mr. Young has had more than 20 years of experience in organization, design, construction, operation and appraisal of power company projects.

C. B. NOLTE

C. B. NOLTE has been elected president of Crane Co., Chicago, Ill. J. B. Berryman, president since 1931 and with Crane since 1892, has become chairman of the board. Mr. Nolte was with Robert W. Hunt Co. from 1909 until his recent election, latterly as president and general manager.

PROF. ELIHU THOMSON, consulting engineer of General Electric Co., noted inventor and research scientist, on his 82nd birthday March 28, received the Grashof Medal of Honor of the Society of German Engineers.

FRANK J. TONE, president of the Carborundum Co., Niagara Falls, N. Y., has been awarded the Acheson Medal by the Electrochemical Society in recognition of his work in electrochemistry and electrometallurgy. He was also first recipient of the Schoelkopf medal of the Western N. Y. Section, A. Ch. S., several years ago.

OBITUARIES

HANS P. HILLSTROM, 60, assistant engineer of the Merrymount Pumping Station, Metropolitan District Commission, Quincy, Mass., died suddenly April 2 at work. He had filled his late post since 1921.

STEWART A. JELLETT, 73, charter member, presidential member and honorary member of the A.S.H.&V.E. and pioneer heating and ventilating engineer, died at his home in Philadelphia April 5 after a lingering illness. From 1885 until illness prevented he was a recognized leader in his chosen profession. From 1889 to 1912 Mr. Jellett was successively engineer, manager, vice-president and treasurer for Francis Bros. & Jellett, Inc., during which time he had charge of all engineering design and construction. From 1912 until his death Mr. Jellett was president of Stewart A. Jellett Co. and was responsible for the design and installation of a great many heating, ventilation and electric generating plants.

BOWEN TUFTS, 50, vice-president of Merrimac Valley Power & Building Co., vice-president and general manager of C. D. Parker & Co., Inc., Boston, and a director or trustee in 48 utility, power, gas, refrigeration and other industrial concerns in Massachusetts, died in Winchester, Mass., April 7.

WILLIAM L. WESCOTT, 71, chief engineer of Oxford Paper Co., Rumford, Me., from 1902 until his retirement in 1930, died at St. Petersburg, Fla., March 22.

STRAWS

Pointing the way business winds blow

GENERAL ELECTRIC CO. has received a $1,250,000 order for the Lackawanna plant of Bethlehem Steel Co., including seven d.c. motors totalling 22,500 hp. for driving the finishing end of Bethlehem's new continuous hot-strip mill—one of the world's largest. This finishing end drive will consist of two 4,500-hp. and three 3,500-hp. motors, and one each of 2,500-hp. and 500-hp. ratings. In addition, the order includes two 3-unit, 6,000-kw. motor-generator sets to supply power for the above motors; one 3-unit, 6,000-kw. motor-generator set to supply power to the drives of two tandem cold-strip mills; the most modern ventilating system yet used in a steel-mill motor room; and complete switchgear and control equipment for the preceding apparatus, including 19 metal-clad oil circuit breakers, each with an interrupting capacity of 500,000 kva.

SIOUX FALLS, S. D., has authorized plans for extensions in municipal electric plant, including new 3,000-hp. generating unit. Cost about $170,000. Bids soon. R. E. Bragstad, city engineer, in charge.

W. VA. BREWING & ICE CO., Parkersburg, W. Va., care of H. G. Smith, Parkersburg, recently organized with capital of $750,000, is considering plans for a new brewery and ice-manufacturing plant in vicinity of Bluefield, W. Va., with boiler house and other mechanical departments. Cost over $200,000, including equipment. A similar project is also under advisement by new company at Charleston, W. Va.

FLINT, MICH., has engaged Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers, to make surveys and estimates for a proposed municipal electric plant. Financing will be arranged.

PLANS are maturing for a new 110,000-volt, 223-mile, transmission line to connect two large hydro-electric power projects now under way by Platte Valley Public Power & Irrigation District, North Platte, Neb., and Loup River Public Power District, Columbus, Neb., for which PWA funds in amount of $7,500,000 and $7,300,000, respectively, have been secured. An award for aluminum conductors for the new line has been made to the Aluminum Co., of America, Inc., Pittsburgh, Pa., at $353,116. Work on the two power projects is advancing on schedule. Donald D. Price is chief engineer for Platte Valley district, while Parsons, Clapp, Brinckerhoff & Douglas, 142 Maiden Lane, New York, are consulting engineers; Fred Albert, Columbus, is engineer for Loup River District, with Harza Engrg. Co., 20 North Wacker Drive, Chicago, Ill., consulting engineer.

OLSEN RUG CO., Crawford & Diversey Sts., Chicago, Ill., has taken a permit to build a new power house for mill service, in connection with a 6-story addition to plant. Work will begin soon. Entire project will cost over $125,000. Weiss & Niestadt, 343 South Dearborn St., architects.

U. S. ENGINEER OFFICE, Customhouse, Portland, Ore., has received low bid from S. Morgan Smith Co., York, Pa., for two 60,000-hp. hydraulic turbines, one 5,000-hp., manually adjusted blade turbine unit, and for governing and auxiliary equipment for all three turbines, for Bonneville Navigation and Power Project on the Columbia River, near Bonneville, Ore., at price of $1,135,329. Award is scheduled to be made at early date. For the same equipment, Allis-Chalmers Mfg. Co., Milwaukee, Wis., tendered a figure of $1,270,319, and Baldwin-Southwark Corp., Philadelphia, Pa., $1,234,478. Bids for other power house equipment and construction are scheduled in May and June. Maj. Charles F. Williams district engineer in charge.

BARRETT CRAVENS CO., Chicago; Bristol Co., Waterbury, Conn.; Cleveland Worm & Gear Co., Cleveland; Fafnir Bearing Co., New Britain, Conn.; and Scovill Mfg. Co., Waterbury, Conn., have become members of Exhibitors Advisory Council, Inc., New York, N. Y., a cooperative service organization which issues data and information on industrial and trade shows.

A JOINT $27,000,000 expansion program in 1935 and several years following will be carried out in Arkansas, Mississippi and Louisiana by the Arkansas Power & Light Co., Pine Bluff, Ark.; Mississippi Power & Light Co., Jackson, Miss.; and the Louisiana Power & Light Co., Algiers, La. New transmission lines, power substations and other service facilities, and increased generating capacity, with extensions in certain present plants and construction of new power stations are proposed over a 5-yr. period.

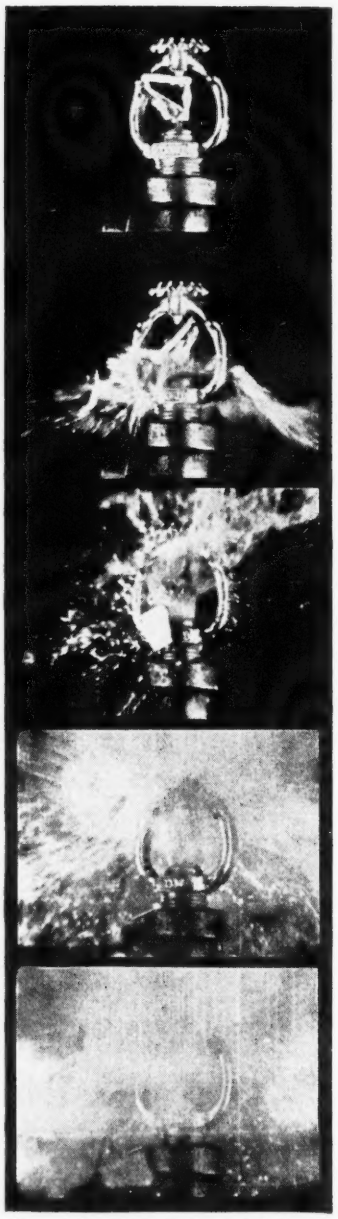
HUTCHINSON, MINN., has voted $250,000 bonds for new municipal electric plant, for which plans will be drawn at once. It is proposed to purchase existing electrical distribution system of the Northern States Power Co. Bids for new power station are expected soon. F. G. Briggs, 1955 University, Hutchinson, Minn.

BOARD OF TRUSTEES, Dominican Sisters Home, Sinsinawa, Wis., has approved plans for new 3-story and basement steam power house at institution, for central heating service, estimated to cost $50,000, with boiler units and other equipment. Contract for building has been awarded to R. F. Conlon & Sons, 880 Locust St., Dubuque, Iowa. Plans are under consideration for developing the plant into an isolated station for electric service at the institution, with installation of generator set and auxiliary equipment.

AUBURN, N. Y., has rejected a proposal for a municipal electric plant, following recent surveys and estimates of cost for such a project, made by Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer. At a special election April 19, the vote was 6293 to 4848 against a bond issue of $1,500,000, required to finance the program.

CUSHING, OKLA., is arranging early call for bids for municipal electric plant, including three 750-hp. diesel engine-generator units, cooling tower, switchboard and instruments, transformers and accessories, with soft-water cisterns and complete accessory structures. Also, for a municipal electrical distribution system. Fund of $340,000 has been arranged. W. R. Holway, 302 East Eighteenth St., Tulsa, Okla., consulting engineer.

UNIVERSITY OF WASHINGTON, Pullman, Wash., has received bids for new addition, 35 x 50 ft., to power plant on campus, used for central power service. Awards will be made at early date. Low bid has been tendered by Allis-Chalmers Mfg. Co., Milwaukee, Wis., at $115,940 for two 1,250-kw. steam turbo-generators, with condensers and auxiliaries, switchboard, switchgear and accessories. University Plumbing & Heating Co., Seattle, Wash., is low bidder for steam, water and air piping in power house at $12,047.



Copyright 1935—Rockwood Sprinkler Co.

WATER DELUGES FIRE IN ONE-TENTH SECOND

These five pictures show a sprinkler head going into action. Taken at a rate of 192 frames per second, these illustrate a total interval of 0.1 sec. More than 12,000,000 sprinkler heads are now installed, and have proved effective in 96% of the cases

DRESDEN PAPER MILLS CO., Dresden, Ohio, has plans under way for extensions and improvements in power plant, to include installation of new boiler unit and auxiliary equipment, fuel-handling apparatus, etc. Estimates of cost and plans are being made by A. M. Kinney, Inc., Carew Tower, Cincinnati, Ohio, consulting engineer.

SHAWNEE, OKLA., plans call for bids early in May for municipal electric plant, including a 300-hp. diesel engine-generator unit and auxiliary equipment. Cost estimated $60,000. W. R. Holway, 302 East Eighteenth St., Tulsa, Okla., consulting engineer.

CARIBOO, $1,000,000 hydro-electric development on Swamp River, B. C., will be begun at once. E. P. Burden, field engineer for Cariboo Development Co., is beginning surveys. The first unit will be 5,000 hp.

MAGNOLIA PETROLEUM CO., Dallas, Tex., has approved plans for extensions and improvements in welded steel pipelines for oil and gasoline service. Close to 700 miles of such lines, now owned and operated by the company, are included in project for replacements and reconditioning, as required. Entire program will cost close to $1,000,000. Construction work by Mitchell-Stewart Construction Co., Dallas.

U. S. ENGINEER OFFICE, Huntington, W. Va., has completed plans and will make early call for bids for construction of new dam on Kanawha River, near Winfield, W. Va., to be used later for a hydro-electric power development. Construction will provide for a dam about 26 ft. high, with clear opening of 100 ft. between piers; it will comprise five standard roller gates and one flap-type roller gate.

R. J. REYNOLDS TOBACCO CO., Winston-Salem, N. C., has approved plans for new power plant. Contract for a 7,500-kw. turbo-generator unit has been awarded to General Electric Co., Schenectady, N. Y.; switchgear and auxiliary equipment will be furnished by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. J. E. Sirrine & Co., Inc., Greenville, S. C., consulting engineer.

KINGSFORD, MICH., is considering construction of municipal electric plant. E. S. Anderson, village manager, in charge of project.

NILES, OHIO, is considering plans for new municipal steam generating plant for central heating service in downtown district, including distribution pipelines. Project is reported to cost over $100,000. Surveys made by Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

BLACKSTONE WEAVING CO., Blackstone, Va., plans early construction of a new one-story boiler plant for service at local mill, where a number of new buildings will be erected. Contracts for building work will be let soon. Entire program will cost in excess of $65,000. Bryan & Terhune, 2 Rector St., New York, consulting engineers.

OWATONNA, MINN., is asking bids until May 13 for addition to municipal power plant, including equipment. Cost estimated $70,000. Frank Snyder, plant superintendent, in charge.

DAKOTA BREWING CO., Bismarck, N. D., care of Fred Peterson, Bismarck, recently organized with capital of $225,000 by Mr. Peterson and associates, plans construction of boiler plant at proposed new local brewery. Entire project estimated to cost $100,000.

BENWOOD, W. VA., is considering a new municipal electric plant. Henry C. Healy, mayor.

VIRGINIA MINN., is considering tentative plans for furnishing service from local electric plant to Eveleth and Mountain Iron, Minn., in same district. Project will include construction of transmission lines, local power substations. Development estimated to cost $70,000. M. C. Bright, superintendent of Virginia power plant.

DANVILLE, KY., has appointed a special committee, headed by R. E. West, chairman, to secure estimates for a proposed municipal electric plant. Report is expected soon.

SPOKANE, WASH., plans new electric-operated pumping station for municipal waterworks. Cost estimated over $250,000 with pumping units and accessories. Water Department in charge.

STATE BOARD OF AFFAIRS, Capitol Bldg., Oklahoma City, Okla., W. C. Hughes, chairman, is planning early construction of power house and ice-manufacturing plant at the Whitaker State Home for Children, Pryor, Okla. An appropriation is being arranged and bids are to be asked soon.

STANFIELD HOSIERY MILLS, INC., Stanfield, N. C., plans new 1-story boiler plant in connection with proposed local hosiery mill, which will consist of three main units. Entire plant will cost over $50,000. Company was organized recently by Brooks Jerome, Stanfield, and associates, with capital of $100,000.

MICHIGAN CITIES NATURAL GAS CO., Union Guarantee Bldg., Detroit, Mich., is arranging for 4- or 6-in. welded steel pipeline to connect with the trunk natural gas system of Consumers Power Co., for service at Midland, Bay City, Saginaw and vicinity. Steel pipe lines for gathering service will also be in the gas-producing districts of Bloomfield and Sherman Townships, Isabella County. During 1935, the company has contracted to furnish over nine billion cubic feet of natural gas.

ELECTRIC POWER CO. OF N. J. plans a $29,600,000 power project on the Upper Delaware River, including three dams and plants between Easton, Pa., and Port Jervis, N. Y. A PWA loan is being sought. Plants would be at Tocks Island near Stroudsburg, Pa., at Belvidere, N. J., 15 miles above Easton, and at Chestnut Hill. Total installed capacity would be 176,400 kw. Hugo A. Spalinski, Trenton, N. J., is president.

BETHLEHEM STEEL CO. has just forged a hollow nickel-steel shaft 47 ft. 2 in. long over-all by 31 in. dia. outside and 21 in. inside for the Mississippi River steamer "Sprague." Weight was 78,305 lb., tensile strength 90,000 lb. per sq.in. The "Sprague," largest river steamboat in the world, was originally designed to tow coal from Pittsburgh down the Ohio and Mississippi. Standard Oil of La. now owns her and uses her for towing oil barges from Baton Rouge up to Memphis.

CARBIDE & CARBON CHEMICALS CORP. has placed in operation its new plant at Whiting, Ind.

SAN ANGELO, TEX., property owners will vote May 14 on issuance $900,000 bonds for a municipal plant.

FORT MCMURRAY, ALTA., is installing a 200-kw. a.c. plant, to be ready by June 1.

WARREN (R.I.) power station, formerly serving the New York, New Haven & Hartford Railroad, but lately withdrawn from service, was slightly damaged by fire April 12. Workmen dismantling a transformer with an acetylene torch took inadequate precautions against ignition of the oil-soaked floor.

U. S. NAVY DEP'T. has ordered electrical equipment totaling $1,750,000 for 18 new destroyers from Westinghouse. Equipment includes turbine-generator sets, regulators and switchboards.

DIESEL-HAULED TRANSFORMER

Wisconsin Public Service Co. needed a Marathon County diesel tractor to haul its new oil-insulated 4000-kva. transformer to Sherman St. substation. The 16-ton Caterpillar easily hauled the 32-ton transformer on a sled. Air-blast blowers will be used on this transformer and the three already installed to increase carrying capacity one-third without overheating insulation.

LAZIEST MAN

Remember about that boy, Humphrey Potter, who was valve tender on one of the first wheezy steam engines back in 1713? (I read it in the aniversary number of POWER last June). Humphrey had one of these "strong back and weak mind" jobs—he shut off the steam and turned on the condensing water when the piston reached the top of its stroke, then turned off the water and turned on the steam again when the piston got back down. It was a nice comfortable job and should have lasted a lifetime.

Well, it was spring, and Humphrey was lazy, so lazy that he knew fishing was the only thing that would help. Now, when some people get lazy, they're willing to do almost anything to enjoy the sensation—maybe even work a little. Humphrey watched the walking beam. When his end went up, he shut off steam and turned on water, when his end went down, he shut off water and turned on steam. The beam and his job were pretty well tied together.

Now here was something? It wasn't much further to the idea that maybe some of his fishline could be used to tie the valve levers and walking beam together—after all he would still have enough to fish with. He tried the tie-up. It worked. Humphrey went fishing.

You see, Humphrey was a lazy kid, so lazy that he'd actually go to the trouble to invent the valve gear just to keep from doing a little hard work.

It's certainly great to be that lazy. Laziness invented the lazy-bar (that goes across a furnace door as a fulcrum for clinker bars) and the lazy-tongs (that looks like a series of X's and will reach out and pick up a nut you've dropped in a place where you can't get to it). If the truth were known, I'll bet it had a lot to do with the easy chair, the telephone, the radio—yes, the water wheel, even the steam boiler and steam turbine.

You can read about lazy men any day in the week—lazy enough to put on a photo cell and alarm to keep from walking outside to see if the stack is smoking, lazy enough to pick out a good packing to keep from changing it all the time, lazy enough to avoid trouble by finding out what goes into the things they buy. I like to be lazy that way myself, so I appreciate it when somebody makes it easy for me to read or understand what he has to say.

Let's take ads for instance. Here's one that reads: " . . . for longer-lasting boiler tubes." Right away I'm all ears, because that saves me work and worry. Another one says, about turbine blades: "corrosion and erosion resisting . . . proper blade angles give maximum efficiency and low steam consumption." I'm interested again. A little one, talking about unit heaters, says: "K.O. that worn-out pipe coil." Now that comes close to home too, because I had a coil go out on me during the cold spell a month or two ago. Missed a Sunday dinner too, getting it replaced. I'm just lazy enough that I'd rather have things I can depend on, and eat my Sunday dinners in peace.

When I'm in a jam I'll read all right, and I'll dig plenty and swear I'll read even the hard stuff so I won't get stuck again. But, when that job is cleaned up, I forget all my resolutions. Maybe, too, the fellow who writes ads like that is lazy too—just lazy enough that he'd rather put good material in what he sells me and tell me he's done it so I don't have to worry. That saves him plenty of worry, and it'll give him time to be lazy too.

George Edwards

GEORGE EDWARDS
Engineer

Why Leading Industrialists Say "THE NEXT BOILER WILL BE AN EDGEMOOR"

•

Edgemoor was established — 1869.

Edgemoor advanced designs have been developed from extensive research in America and Europe.

Edgemoor has a most experienced personnel. The Highest Pressure Boiler and Power Plant in America and the largest High Pressure Plant in the world was designed and constructed by part of our present personnel.

Edgemoor builds the complete steam generating unit in their own shop. No assembly from various part manufacturers.

Edgemoor forms and welds their own welded drums including X-Ray inspection and stress relieving in their own furnaces.

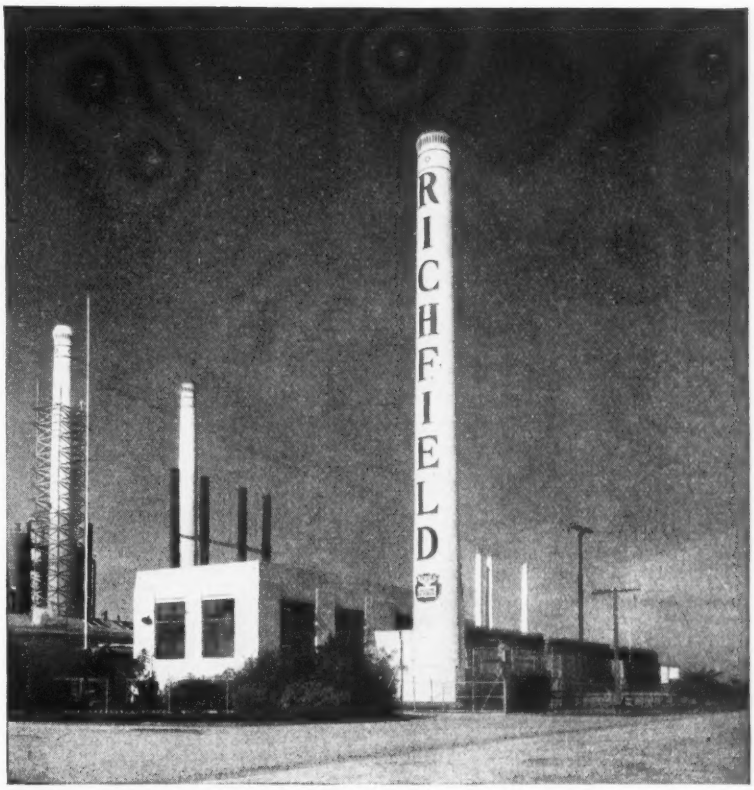
Edgemoor does an unusually high grade job of tube bending to templates in their own shops. Edgemoor maintains their own tube bending shop equipped with all modern tube bending equipment.

Edgemoor provides carefully drilled tube holes in drums and headers securing a very smooth tube seat.

Edgemoor grinds and finishes the tube ends in order to secure desirable contact in drum and header seats.

Edgemoor has established new shop methods and personnel, thus permitting attractive quotations.

Edgemoor offers a complete steam generating installation with Edgemoor overall responsibility.



EDGEMOOR IRON CO.

EDGE MOOR, DELAWARE

Established 1869

OFFICES IN ALL PRINCIPAL CITIES

STRAIGHT and BENT TUBE BOILERS, WATER WALLS, *Furnace Enclosures* . . . ECONOMIZERS, *Integral or Separate, Flooded or Steaming* . . . SUPERHEATERS, *All Types and Arrangements* . . . WASTE HEAT RECOVERY SYSTEMS for *Blast Furnaces, Cement Mills, Steel Furnaces* . . . DIESEL ENGINE EXHAUST HEAT BOILERS, PRESSURE VESSELS, *Fusion Welded of Various Alloys, Class 1 and 2* . . . CHROME NICKEL and OTHER ALLOY . . . FABRICATION . . . HEAT TREATING and STRESS . . . RELIEVING FURNACE SERVICE . . . X-RAY INSPECTION SERVICE . . . EDGEMOOR PULVERIZERS, *Both Impact and Table Roller.*

NEW BULLETINS

Stokers — Combustion Engrg. Co., 200 Madison Ave., New York, N. Y. 16-page Catalog E-8 describes Type E center-retort underfeed stoker, giving construction, operation and control. Also diagram showing typical ashpit and air duct arrangements, as well as applications to various types of boilers.

Diesel Engines — Worthington Pump & Machinery Co., Harrison, N. J. 16-page Bulletin S-500-B6D, "Worthington Diesel Engines Vertical 4-Cycle Direct-Injection, Types B, C, D, E," gives specific information on engines from 25 to 1,000 hp., and 1 to 8 cyl., and general data on diesel construction and applications for industrial service. Also a sectional view of typical engine, and photographs of installations with various types of drive.

Metal-Spraying Equipment—Metals Coating Co. of America, 495-497 N. Third St., Philadelphia, Pa. Two bulletins. 8-page "MetaLayer, A Process and Equipment for Applying Sprayed Metal Coatings," summarizes data on process. 4-page Bulletin 1202 shows accessory equipment.

General Electric—General Electric Co., Schenectady, N. Y. New bulletins include: 19-page GEA-897E, "Air-Cooled Transformers for Lighting and Power Service," 34-page GEA-1305C, with supplement, on Luminous Tube Transformers, 4-page leaflet, GEA-1488A, on MC-5 Air Circuit Breaker for Frequent Operation and Severe Duty, 2-page GEA-286D on Full-Bolted Electric Power Connectors, 8-page GEA-1358A on Control and Signal Transformers, 2-page GEA-2023 on Moderate-Duty, Moderate-Priced Outdoor Group-operated Switch, Type TC.

Refractories — General Refractories Co., 106 South 16th St., Philadelphia, Pa. Series of 10 booklets on company products and field. First, "Refractory Products and Service," gives information on company and its 20 plants, lists sales offices, describes testing laboratory and 12 main products. Four bulletins on products—Fire Clay Brick, Plastic Fire Brick, Chrome Base High-Temperature Cement and Fire Clay and Cyanite Base High-Temperature Cement. Four on use of refractory products in important fields: Boiler Plants, Metallurgical Processes, Oil Refineries and Rock Products Industries. Also separate bulletin on refractories produced in Southern plants. All bulletins same size, punched for binding.

Mercury Arc Rectifier — Allis-Chalmers Mfg. Co., Milwaukee, Wis. 20-page Bulletin No. 1168 on Mercury Arc Rectifiers for Power Conversion in Electrolytic Plants, giving engineering information.

Tanks and Industrial Equipment—L. O. Koven & Brother, Inc., 187 Ogden Ave., Jersey City, N. J. 52-page catalog outlining in detail extensive services of this company to industrial fields. Many illustrations of entire range of plate and sheet metal construction. Included are sections on tanks for process and storage, equipment for chemical and allied industries, mixers, equipment for food industries, equipment for machinery metal product plants, public utilities, railroads, etc., containers, miscellaneous plates and sheet metal construction, including chutes, hoppers, piping, stacks, and built-up welded construction.

Belt Drive—E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa. 16-page booklet, "Vim Short-Center Drive With Vim-Tred Leather Belting," gives basic data. Also available is a complete handbook on short-center drives, containing specification on over 5,000 drives at every speed and pulley ratio up to 1-6.

Steam-Jet Ejectors — Elliott Co., Heat Transfer Dept., Jeannette, Pa. Bulletin illustrating and describing wide range of ejectors from 1-in. priming ejectors to 30-in. booster ejectors, giving theory, describing single- and multi-stage units, boosters, material of construction, operation and application in processes.

Gate Valves — The Lunkenheimer Co., Cincinnati, Ohio. 8-page bulletin, "For Corrosive Service—Lunkenheimer 'Causul' Metal Gate Valves, With Alloy Trim." Gives specifications, applications and engineering data.

Washers and Stampings — Wrought Washer Mfg. Co., 2100 S. Bay St., Milwaukee, Wis. Handbook, "Special Washers and Stampings," lists more than 19,000 shapes, sizes and specifications of washer stampings and miscellaneous assembly parts for mechanical products. Of interest to power equipment designers.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Harrison — City defeated $130,000 bonds for construction of electric plant.

Calif., San Jose—Santa Clara Valley Water Conservation Dist., Grant Bldg., seeking P.W.A. funds for construction of following: $1,964,000 for reservoir on Coyote River at Upper Gorge site, Madrone; $1,026,500 for distributing system from Coyote Reservoir along west side of valley north to Permanente Creek and on east side of valley north to Penetencia Creek; $70,448 for power plant development to be operated from Coyote Reservoir release and power used to lift water into above mentioned distributing canals; $700,000 for reservoir in Los Gatos Creek by constructing dam near Lexington. F. H. Tibbetts, Alaska Comm. Bldg., San Francisco, engr.

Ill., Chicago—Olsen Rug Co., 2800 North Crawford St., plans by Weiss & Niestadt, 343 South Dearborn St., power house and other plant works. To exceed $30,000.

Ia., Boone—City defeated $850,000 bonds for constructing light and power plant. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, engrs.

Ia., Iowa City—City Council voted to construct municipal light and power plant. $917,000. Will apply for P.W.A. funds.

Ia., LaPorte — Municipality plans diesel engine municipal electric power plant. $100,000. Young & Stanley, Muscatine, engrs.

Kan., Burlington — City voted to construct light plant. $145,000. Awaiting final decision of Supreme Court on injunction. E. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs.

Me., South Portland — State, Office of the Governor, State House, Augusta, plans central heating plant and laundry building, and dairy barn at State School for Boys. $76,500 appropriated. Architect not appointed.

Md., Cumberland — City, electric light and power plant. $1,500,000. Engineer not appointed. Project abandoned. Enabling act not passed by Legislature.

Mass., Holyoke — Chemical Paper Mfg. Co., plans hydro-electric plant for paper manufacturing. Est. about $120,000. R. L. Bosworth, c/o owner, engr.

Mich., Mt. Pleasant — City bond election Apr. 29 for construction of power and light plant. $400,000.

Minn., Hutchinson—City, A. D. Adams, clk., plans electric light and power plant and purchasing distribution system from present owner, $250,000 bonds voted. E. G. Briggs, 1955 University Ave., St. Paul, engr.

Minn., Owatonna—Bids May 13, by City, Public Utilities Comn., 50x66x55 ft. power plant addition, $75,000. F. Snyder, supt. power plant.

Missouri—Eastern Industrial Mfg. Concern, J. N. Dunham, archt., Chemical Bldg., St. Louis making sketches for group of buildings incl. 70x155 ft. power plant, on 14 to 20 acre site to be negotiated for an eastern industrial manufacturing company. Name withheld.

Mo., Memphis — City improving municipal light and power plant. $8,500. P.W.A. grant rescinded. C. J. Weigner, city engr.

Neb., Columbus—Bids May 24, by Loup River Public Power Dist., hydro-electric power house, near here, incl. 30,000 cu.yd. excav.

Neb., Monroe—Bids May 24, by Loup River Public Power Dist., 2307 13th St., Columbus, constructing hydro-electric power house, near here, incl. 16,700 cu.yd. excav. P.W.A. project.

N. J., Long Branch — Monmouth Memorial Hospital plans by Epple & Kahrs, 17 Washington St., Newark, constructing laundry and power plant, 3rd Ave. $69,000.

N. Y., Auburn—City defeated bonds and will not build power plant, $150,000. Project abandoned.

N. Y., Canisteo—Village plans installing electrically operated pumping equipment, increase in storage capacity of reservoirs and improving well supply. Public Service Comn. approved transfer of property, franchise, etc., from Canisteo Waterworks Company to village. Properties located in village and town of Canisteo and town of Hornellsville, Steuben Co.,

N. Y., Lynbrook—Village appropriated $3,000 for survey to determine feasibility of constructing electric power plant. H. G. Wilson, mayor.

N. Y., Port Jervis — City plans municipal diesel generating unit for street lighting. $10,000. Utilities Eng. Co., 1 Columbia Pl., Albany, engrs.

N. Y., Valatie—Voted $59,000 bonds for generating plant and buildings.

N. D., Noonan—POWER PLANT—Baukol Noonan Lignite Coal Co., Noonan, plans electric power for coal mining and coal handling. $28,000.

O., Cleveland — Cleveland Railway Co., C. Stanle, purch. agt., Midland Bldg., plans by L. B. Bale, Midland Bldg., 1 story, basement, brick, steel booster sub-station. $50,000.

Pa., Corry — City, G. Miller, mayor, plans municipal light and power plant. **Maturity indefinite.** To exceed $28,500.

Pa., New Castle — City cancelled plans for $3,750,000 bond issue for construction of municipal light and power plant. G. Throop, city engr.

Okla., Cushing—Municipality soon takes bids electric power plant. W. R. Holway, 302 East 18th St., Tulsa, engr.

S. D., Sioux Falls—City, A. Norstad, aud., plans furnishing, installing 3,000 hp. power generating outfit at municipal power plant. $175,000. R. E. Bragstad, city engr.

Tenn., Johnson City—Municipality, plans application to P.W.A. for loan to finance construction of electric transmission and distribution system. $700,000.

Tex., Brownwood—R. O. Mathews, Brownwood, plans electric light and power plant, incl. entire system of underground lines and appurtenances, power plant building to house all operative machinery and equipment, etc., complete dynamo unit sufficient to operate plant. $150,000 or more. Interested machinery, equipment dealers, etc., get in touch with owners at once. H. O. Clark, 627 North 23rd St., Waco, engr.

Tex., Liberty—City, c/o F. S. Griffin, mayor, making final plans electric light and power plant and distribution system, brick buildings, generating plant and equipment, primary and secondary distribution system, street lighting. $95,200. Garrett Eng. Corp., 300 Hughes St., engrs. P.W.A. project.

Tex., San Angelo—City, c/o E. E. Lowrie, mgr., election May 14, $900,000, municipal power plant. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Tex., Teague—Texas Utilities Co., Teague, Dallas, plans modern 60 ton capacity, ice manufacturing plant, incl. latest machinery and equipment to replace one recently destroyed by fire. Engineer, c/o owner, engr.

Wash., Spokane — City announced P.W.A. allotted $623,573 for constructing hydro-electric plant and 243 ft. rein.-con. dam, 54 ft. high, and three 1,800 hp. generating units in power plant. 42x90 ft. power house, 28 ft. high. A. D. Butler, city engr.

Wash., Yakima—Municipality plans electric light and power plant. To exceed $30,000.

B. C., Vancouver — Cariboo Hydro-Electric Power Co., 675 West Hastings St., preliminary surveys now being made by F. P. Burden, civil engr., c/o D. R. Blair, agt., 675 West Hastings St., for proposed 5,000 hp. electric power plant. No decision on construction of same yet made.

Ont., Hamilton—Hill Steel Constr. Co., 902 Bank of Commerce Bldg., making plans constructing plant and power house, Burlington St. $80,000. Private plans.

Que., Montreal—McGill University, Sherbrooke St. W., plans by A. J. C. Paine, Newfoundland, for gymnasium building, armory, administration offices, skating rink, swimming pool and power house. $1,000,000.

New Zealand, Wellington—Bids June 18, by Secretary Public Wks., Supplies & Tenders, Committee, two 33,000 volt outdoor type oil immersed circuit breakers for solenoid operation; June 25, supplying three 1,500 kva. single-phase, transformers to transform 110,000 volt, 3 phase to cycle power, to 11,000 volt.

Crimea, Ai-Petri — Electric Power Trust, Soviet Government, or c/o Amtorg Trading Corp., 261 5th Ave., New York, plans 10,000 kw. wind-electric generating plant. Kondratuck & Korchakox, c/o owner, engrs.